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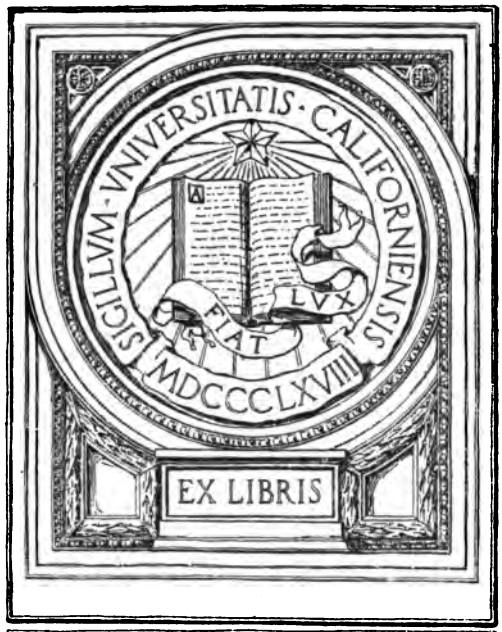
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THE MINNESOTA HISTORICAL SOCIETY.

WILLIAM H. LIGHTNER, President. WARREN UPHAM, Secretary.

THE WEATHERING OF ABORIGINAL STONE ARTIFACTS NO. 1.

A CONSIDERATION OF THE PALEOLITHS OF KANSAS

(Illustrated by 20 figures and 19 half-tone plates

By N. H. WINCHELL.

Collections of the Minnesota Historical Society, Volume XVI, Part I.

ST. PAUL, MINN.

1913.

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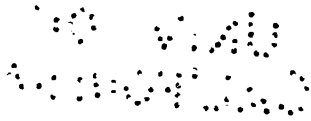

St. Paul, Minn., Oct. 10, 1912.

PRESIDENT W. H. LIGHTNER.

My Dear Sir:

In accordance with the recommendation of the Museum Committee a manuscript entitled "A consideration of the Paleoliths of Kansas" is herewith offered for publication It is a further result of the examination of the collections amassed by the late J. V. Brower.

Respectfully,

N. H. WINCHELL.

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264129

DEDICATION.

To Dr. Charles Conrad Abbott,
Trenton, N. J.

I beg the honor and the privilege of inscribing to you the following work on the "Weathering of Aboriginal Stone Artifacts." Never having met you, not knowing you by sight, I can assure you that it is only because of my admiration of your skill, and your persistence through more than forty years, in describing the occurrence of paleolithic stone artifacts in the Delaware valley, that I am moved to offer you this testimonial of esteem.

N. H. WINCHELL.

St. Paul, Minn., April 30, 1913.

Preface.

One of the most interesting, as well as the most important, questions that concern man is that of his antiquity. In America, as in Europe, for many years it has been much discussed, but in America archeologists are not in as good concord on the fundamental ideas as in Europe. The leading American authorities are about where the European were prior to the discoveries of Boucher de Perthes. That is about the same as saying that in America authoritative archeological opinion on this subject is about sixty-six years behind that of Europe. It is true that human artifacts in the river gravel at Trenton, New Jersey, were announced in 1872 by Dr. C. C. Abbott, who is the Boucher de Perthes of America, and have been described elsewhere, but to this day all discoveries of pre-Glacial human remains, whether bones or implements, have been discredited and discarded by the powerful influences that are localized at Washington, and the existence of man in North America earlier than "the Glacial epoch", i. e. the Wisconsin ice-epoch, is tabooed. The effect of this leading has been so pronounced that in most of the museums of the country, outside of New England, it is vain to search for any labels that indicate pre-Glacial man in America.

There is a singular anomaly in the course of numerous American archeologists in this matter. Admitting that European study of aboriginal stone artifacts ante-

dated American, they accept the conclusions of European experts as to the names and uses which they ascribe to American specimens, adopt the terms applied to their culture stages, their classification and definitions; practically therefore European archeology has been transplanted to America, though with some extensions and modifications. But, the *signs of age* when discovered in America are rejected, in such a manner that, to be philosophic and reasonable, it becomes necessary, in order to justify such rejection, to assume that in America, the difference of longitude, or of climate, or manner of exposure to the atmospheric elements, was so powerful that we cannot expect in America the same results as in Europe. If that be true, it is an important new element in natural physics, and were it to be applied generally it would be incumbent on American geologists and geographers, as well as all natural scientists, to reconstruct the sciences which are current, and to build up from the foundation a special code of American sciences. But the work which follows is based on the assumption that natural forces have operated in America in the same manner as in Europe, and have produced identical results. The *patination of flint* is accepted in Europe as an indication of great age. When found on similar artifacts in America it has the same significance. Not only do European specimens show the well-known patination indicative of Paleolithic date, but African and Asiatic stone implements, when they possess this evidence also are classed uniformly with European Paleoliths. It seems that, in order to be justifiable in the rejection of this evidence in America, the burden of

proof rests upon the objectors. They should show, either that what in this work is called patination is not patination, or that different natural causes have produced in America those results which in Europe are ascribed to patination.

No one, reading American literature devoted to stone artifacts, can fail to notice the paucity of descriptions and discussions made from the geologist's point of view; that too when the nature of the specimens and their environments were more or less geological, and when a careful examination by a competent geological observer would have added materially to their significance and to their value. The archeologists of America have usually not been equipped with geological training. They have gathered, with great assiduity a vast number and variety of aboriginal implements, and have assigned them in many cases to their supposed uses. They have filled their cases with "beautiful" specimens, and have dazzled the visitor with skillful arrangements from shelf to shelf. They have had little concern for the question of the relative ages of these specimens, and usually they have considered all their collections from American localities as the product of the historic Indian. More recently, as the question of Paleolithic man in America has been revived, while discerning the need of geological investigation, they have still been content to submit the inquiry to archeologists who made no pretense of geological skill, or to geologists who, with superficial and insufficient investigation, were satisfied to corroborate the views of their archeological associates. Thus in some notable instances the geological evidence

of the antiquity of man in America has been glozed over, and in others seems to have been distorted and ignored; at the same time geologists generally are too intent on the facts of their own science to give heed to that dim border-line which separates man from geology. It will be probably many years before the Pleistocene relations of man in America can be worked out with that particularity which has been attained by recent work in Europe.

If there be one portion of American geological history which more than any of the others has undergone modification in recent years, as geologists have pushed their investigations to greater detail, it is that which is called Glacial Geology, or, in broader terms, Pleistocene Geology. In this remarkable modification it is notable that in all cases, as new features have been discovered, it has been necessary to lengthen rather than shorten the time involved. Thus, the "Glacial Period" which was at first believed to have been a simple, single and unique phase of Pleistocene time, has been doubled and quadrupled in its recurrent phases, and hence has been doubled and quadrupled in its complexities, as well as in the time needed to warrant such physical revolutions as are evident. Some of the momentous topographic changes of the western United States have been effected by volcanic action and by erosion, since the close of the Tertiary. Thousand of square miles have been covered by volcanic lava floods and have been given a new topography by post-Tertiary erosion. It is only recent that it has been found necessary to take cognizance of this great lapse of time since the close of the Tertiary,

and it has not yet been found possible, in all cases, even to distinguish between the later Tertiary and the early Pleistocene; nor is it to be wondered at that in some instances no notice whatever has been taken of this long Pleistocene period, and that in the discussion of human antiquity no room has been left for the existence of man between the Tertiary and the historic Indian, i. e. between the Tertiary and the Neolithic.

If the writer has succeeded in showing, in the pages of this little work, that man existed in Kansas throughout at least the Glacial period, with its many phases, he has opened the door through which proof may flow eventually that man occupied the entire North American continent during the same period and that he witnessed many of the convulsions of the western states which were marked by violent volcanism, as well as the more gradual changes of topography consequent on floods and their resulting erosions, which marked the successive Glacial epochs.

Scientific workers in America are not numerous, and they are often handicapped by poverty of resources and of time. They do not always agree in their conclusions, but there can not be found a body of men more unreservedly devoted to the single cause of the advancement of truth. They are subject in their researches only to errors of judgment, not to lapses of integrity. Therefore whatever their differences on scientific questions they should be credited with honesty of motive and conviction, for however great those differences it requires only the further prosecution of research to prove where the truth lies. It behooves

them to be patient and conciliatory with each other, and to have constant willingness to accept new facts whenever and wherever they appear, and whatever may be their bearing on their own views.

The writer contemplates a similar treatment of human implements from other states in the near future, and he asks the co-operation of American archeologists.

A brief announcement of these results was published in *Records of the Past*, July-August, 1912. A more extended account was presented at Geneva, to the Congrés international d'Anthropologie et d'Archéologie préhistoriques, September, 1912. They were discussed in a paper read in December, 1912, at Cleveland O., before Section H of the American Association for the Advancement of Science, and in January, 1913, at Milwaukee, before the Wisconsin Archeological Society and before the Minnesota Academy of Science at Minneapolis.

N. H. WINCHELL.

St. Paul, April 18, 1913.

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PRELIMINARY NOTE.

The results presented in this paper, and the evidence on which they are based, were theoretically anticipated by the writer prior to the examination of the artifacts. Indeed they were first confirmed by an earlier cursory handling of a large collection of "Mandan" flint artifacts collected by Mr. Brower for the Minnesota Historical Society; but at that time it was inconvenient to enter upon the discussion. Similar conclusions seem to be warranted by the weathering of some Oklahoma specimens. In later discussion these facts will be presented.

The main purpose of this note is to call attention to the fact that Mr. Brower was fully aware of the important bearing of the rude culture of the "Quivira" on the question of paleolithic man in America, as shown by the following quotation from his **Harahey** (p. 109):

"I was so impressed by the developments of unusual interest, indicating the existence of two stages of ancient culture near the Kansas chert beds, that a series of the chipped implements of each nation was submitted for inspection to the authorities of the United States National Museum at Washington. Dr. Thomas Wilson has replied quite fully, and that portion of his last communication which relates particularly to the Quivira and Harahey implements is available to indicate some of the difficulties encountered.

"'Smithsonian Institution,
U. S. National Museum,
Washington, D. C., Feb. 3, 1899.

Mr. J. V. Brower,
St. Paul, Minn.

Dear Sir:—

I do not know what your discoveries of new implements and different stages of culture in the same neighborhood is going to delvelop, but it is surely remarkable and opens up a new vista which should be pursued and explored to the very end. I conclude that you are the only individual qualified to make the investigation, and I think the responsibility of pursuing it will rest with you.

Yours very truly,

THOMAS WILSON, Curator,
Division of Prehistoric Archeology.

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"Eminent archeologists, appealed to for assistance and advice in the preparation of these papers, are unable to definitely conclude new questions which have arisen during the continuance of these explorations in Kansas, and the fact that some of the rude implements found there indicate no higher culture than existed probably 50,000 years ago in the Somme Valley,* France, places a responsibility upon me which I have been cautious to assume, on account of the wide diversity of opinions in archeologic matters relating particularly to American anthropology."

It is in continuation of the examination of the specimens gathered by Mr. Brower, and the work which they entail upon the Minnesota Historical Society, that the writer has prepared this paper. To the late Dr. Thomas Wilson must be given the credit, as appears from the foregoing and from other excerpts from his letters which have been published by Mr. Brower, of detecting the paleolithic character of the rude artifacts assigned by Mr. Brower to a tribe of historic Indians. Mr. Brower shrank from the labor and the responsibility of the task pointed out by Dr. Wilson, of pursuing the "new vista" opened up by the discovery "to the very end." Hence the subject has remained dormant for thirteen years. N. H. W.

August, 1912.

*"**Primitive man in the Somme Valley,** by Professor Warren Upham, Vol. XXII, p. 350, **American Geologist,** December, 1898. Professor Upham conducted a critical examination of the locality mentioned in 1897, by observations based on Glacial Geology."

THE WEATHERING OF ABORIGINAL STONE ARTIFACTS.

I. A CONSIDERATION OF THE PALEOLITHS OF KANSAS.

Without calling in question the identification of Quivira by Mr. J. V. Brower, and the distinction to which he called attention between the artifacts found in one part of the area and those found in another, which he has delimited on his various maps in "Quivira," "Harahey," and in "Kansas," there are certain important other facts which seem to require a profound modification of his archeological reasoning.

1. The coarsely chipped large artifacts which Mr. Brower attributed to the Quivirans (Wichita Caddo) are not characteristic of that branch of the Caddo people, nor of any other branch, nor of any existing Indian people of America. They are distinctly paleolithic and manifest all the characteristic features of the paleolithic artifacts of Europe as stated by Evans in his work, "Ancient Stone implements of Great Britain."

2. They have been secondarily chipped by a later people, and this later people have left their work strewn up and down the Kansas valley and its tributary valleys. This later people may have done independent quarrying in the cherty limestone.

3. These paleolithic artifacts are south from, but quite near, the oldest known glacial moraine of the

ice-age, the northeastern corner of Kansas having been invaded by the Kansas ice-sheet. An outline map of this section of Kansas has been constructed by the aid of Prof. J. E. Todd, showing the Glacial geology. (See Plate-map).

4. The area of the Quivirans, as marked out by Mr. Brower, takes in a part of the elevated lands which are underlain by the chert-bearing limestone, which was not disturbed by the ice-movement, nor covered by a sheet of Glacial drift of any kind.

5. The area of the Haraheyans (of Brower) is further north and further east, and was in part involved in the events of the near-by Glacial moraine, at least so far as the abundant waters from the dissolving ice were able to spread a sheet of gravel and sand, or of loess, along the valleys. Hence

6. The rude artifacts from the chert-bearing upland when not wholly buried from sight, are found mixed, in the valleys, with the more finished artifacts of the later people, some of the former being partially (and frequently wholly) re-chipped.

7. The stone artifacts show therefore two (or three) ages of stone-working, one being perhaps pre-Glacial, or inter-Glacial (if not both) and one post-Glacial. The corresponding inter-Glacial terms would probably be Pleistocene (or Aftonian), Buchanan and Recent.

There are several other interesting propositions that might here be given, but they will appear more reasonably in connection with the circumstantial discussion of these, and their perfect adjustment with these will serve to elucidate and confirm these. Mr. Brower's

great work in establishing Quivira in the Kansas river valley, and having it marked by a granite monument at Logan grove,* cannot be called in question. It is in his attempt to adjust his discovery with discovered archeologic facts, and with aboriginal history and tradition, that the writer thinks that some change should be made—a change, moreover, which, if Mr. Brower had apprehended it, he would have welcomed, since it furnishes another confirmation of one of the leading ideas of his archeological work—the existence of pre-Glacial man in America.

Near the close of Mr. Brower's work in Kansas, he collected, boxed and sent to St. Paul, with the aid of Judge J. T. Keagy of Alma, living in the valley of Mill Creek, in Wabaunsee county, a large number of those coarse artifacts. This collection came from "Quivira" village sites in Morris, Geary, Riley and Wabaunsee counties, and from various isolated spots, and in the course of examination of Mr. Brower's extensive collection has just been reached (January, 1912). The sites are often well up toward the crest where the uplands break down in undulating slopes and descend into the valleys. The upland divides between adjacent creeks (such as Humbolt and McDowell) on the northwesterly side of the range, are narrow, and it was easy for the people who lived on the northwesterly side to pass the crown of the upland and find suitable sites on the upper slopes of the southeastern side. (V. *Kansas*. pp. 101-102).

*Logan Grove is on the land of Capt. Robert Henderson, near Junction City. Later Mr. Brower was instrumental in having similar commemorative monuments erected at Manhattan, Alma and Herrington.

(a). *Patina* consisting of a superficial change of color. The dark gray and the blush-gray cherts have a tendency to become much lighter colored, approaching white (and sometimes light brown) and the light gray has a tendency to become yellowish, passing through buff to yellowish brown.

(b). *Patina* consisting of a polished, or glossy surface. This glossy surface is usually more pronounced on one side of an artifact or chip than on the other, as if one side had been less exposed to the atmospheric agents. It is often visible on both sides, but there are some that do not show it noticeably on either side, although belonging by culture in the same class. This glossiness of course has obliterated all the fine, sharp angularities due to the fracturing of the grain of the chert, but it has not destroyed the coarser angularities (aretes), such as are produced by the intersections of fracture planes. It smoothes off the edges and descends into the main undulations of the chipped surfaces. Some have described this glossines as a "burnishing," but if it were produced by a burnisher, it was one that accommodated itself to the inequalities of a very uneven surface. On making a new chipping from one of these glossy specimens, so directed as to cause an intersection of the new surface with the glossy surface, the contrast presented by them is quite evident. The fresh surface is dull gray, does not reflect the light from the window and has the feel of a fine roughness, while the old surfaces reflect the light successively as the turning of the specimen brings them into the proper angles.

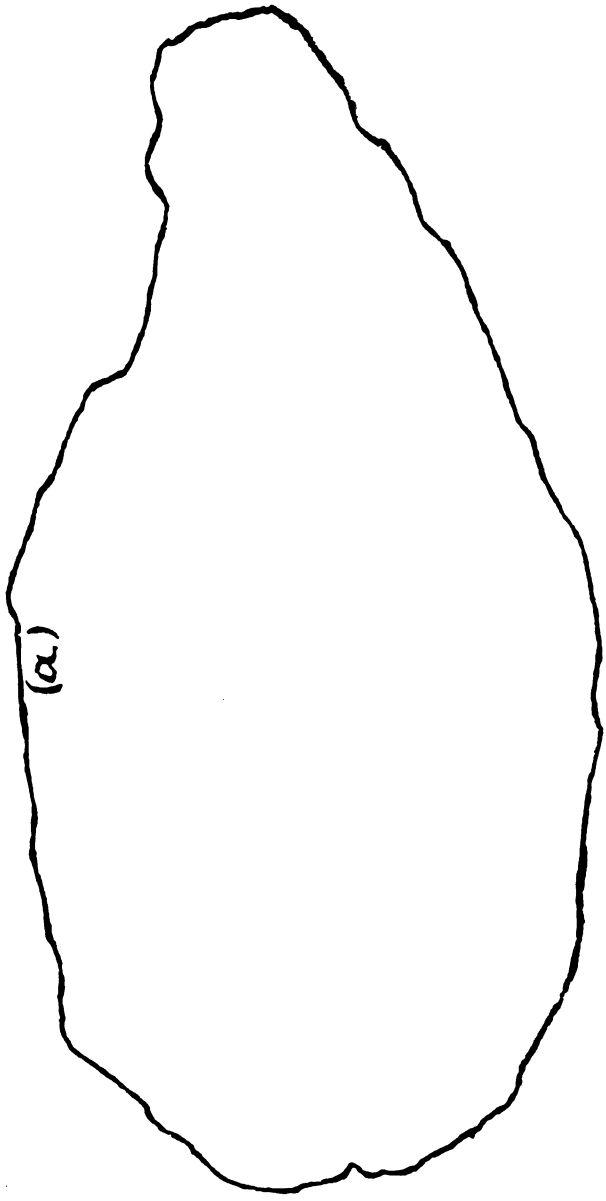
This patina, whether change of color or loss of the fine asperity of the original fracture, is very thin. Its thickness usually cannot be seen with the unaided eye. Frequently both characteristics are seen on the same specimen, and on the same surface, indeed usually they go in company.

(c). There is also another form of patina, which appears on the grayish-blue specimens. In this case, while there is no marked glossiness there is a change of color throughout a surface layer about as thick as card-board, or letter paper, the color assumed being a dirty gray and brownish gray. This change screens entirely the bluish tint of the interior, and when a chip is removed not only the color of the coating can be seen but also its thickness. This form of alteration is due probably to protection from the impact of atmospheric agents, by burial beneath a rubbish of chert and soil, and its significance is nearly the same, as to age, as the forms (a) and (b), but in numerous cases it is older than (a) and (b).

(d). Occasionally can be seen scattered spangles and non-reflecting specks of what appears to be black oxide of manganese, but this has not been analyzed, and is not common.

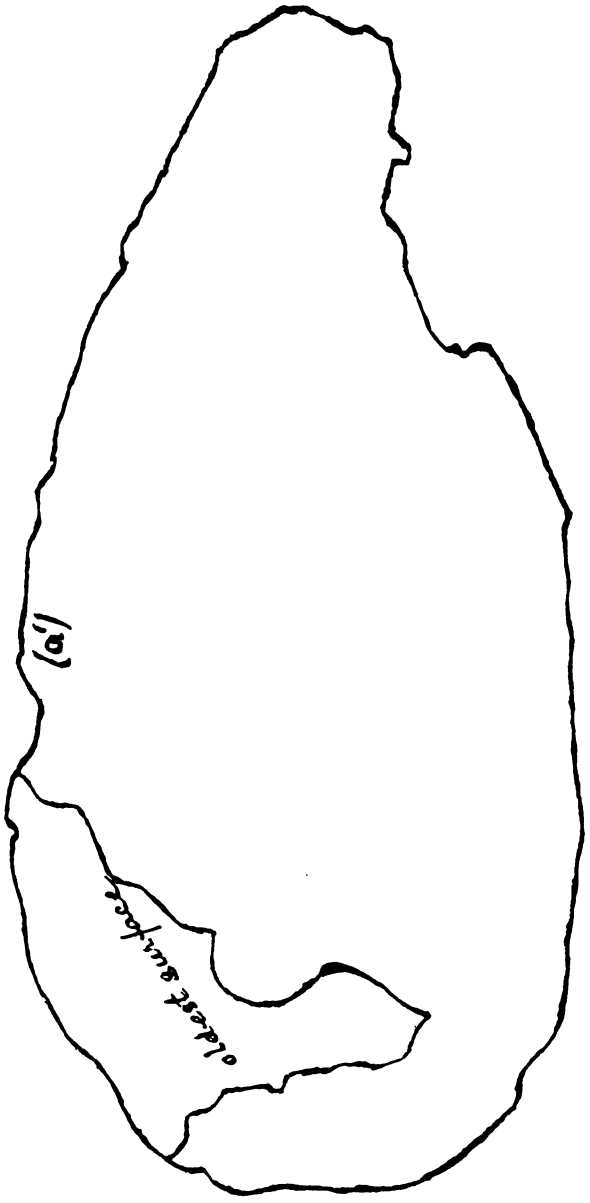
(e). There is also a persistent thin dirt-colored patina which cannot be washed off, nor removed with a brush and warm water. This is very common on all the old surfaces, but is absent from modern artifacts. It is later than the glossy surfaces. It is only in this patina that have been observed (though rather doubtfully) the peculiar spots described by Evans

recent chips have been flaked from the edges and from the small end, revealing the fact that the interior color is a mottling of gray of differing shades, and



Outline of a Paleolith from Feuardent, France.

proving that the yellow and buff tones and the glossiness have been acquired by weathering. These acquired tones do not pierce the substance of the chert



Outline of a Paleolith from Feuardent, France.

to any appreciable thickness, but the oldest surface, which came next to the rock matrix, is changed to a nearly white color to a depth of one thirty-second part of an inch to one-sixteenth part, and its texture is finely granular and harsh to the finger-nail. This yellow-buff color, which is more pronounced on one side (a) than the other, must be considered, therefore, as a *patina* formed by long weathering. It is not a glacial coating, but a weather-coating.

The other side of this specimen (a′) likewise evinces its age by a similar alteration of color, but much less marked. Indeed this side is almost wholly mottled gray, with only a faint clouding by buff. All over this side, however, are small scattered specks of limonite, or limonitic manganese, of about the size of a common pin head. This side was probably turned downward during a long period while the other side was exposed to the sun and the friction of atmospheric precipitation and wind. Both sides are "polished" or "burnished" but the *a* side is the smoother. In no case is there any perceptible (though there probably is an actual) loss of sharpness at the angular edges of the flaking, although that sharpness is sometimes dulled by small chippings due to use and to rough handling.

The specimen is a typical Paleolithic implement, judging by the roughness of the flaking, no less than by the age which it evinces, or the source record which accompanies it.

2. The second European Paleolith selected for comparison (b) is a rude and apparently purposeless implement, still more altered by long weathering, having almost uniformly the same yellowish color, but

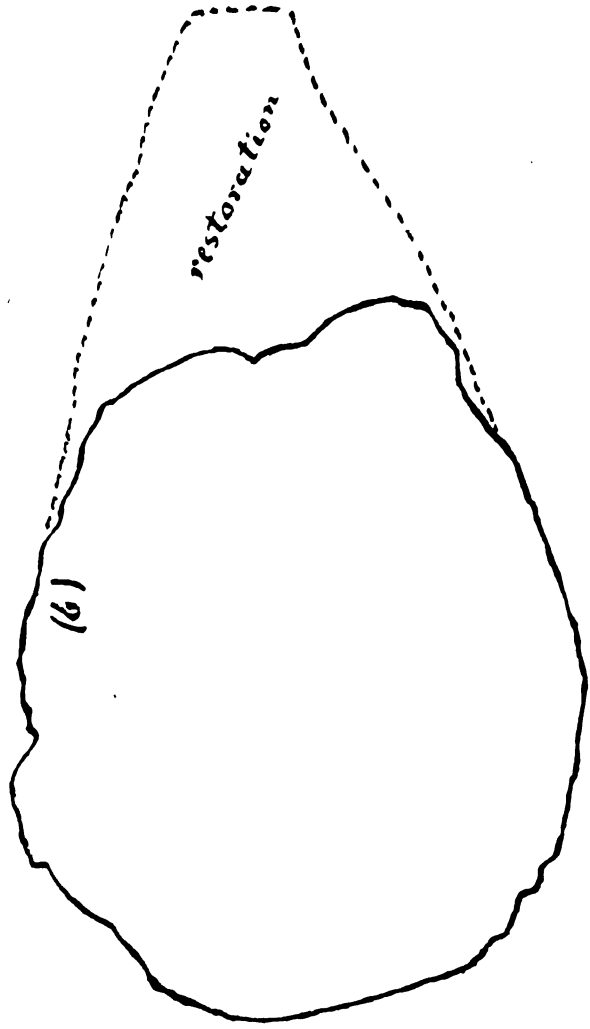
slightly showing a shading toward dark amber color. This specimen is apparently only a part of the original implement, which was broken before it was weathered, and corresponds to the larger end of the specimen last described. In the same manner, and approximately in the same part of the specimen, is preserved a portion of the original matrix-surface.

On fracturing this specimen the interior color is found to be gray, entirely like that from the Loire Bassin. Adherent to the larger end is some rusty grit derived from drift, cemented by limonite.

These two specimens can reasonably be taken as typical of the chert implements which are buried in the drift gravels of the regions mentioned,* and hence as guides to Paleolithic specimens of the same material found in America. The chief characteristic is the nature of the *patina*. The surface of the chert is turned to honey-yellow of varying shades, but the original gray of the chert occasionally gives a darker shade to the patina, and on protected surfaces it shows through the patina and appears to be almost unchanged. Besides this patina there is a glossy smoothness which is superior to that of recently flaked chert. This smoothness is not due to use as an implement, for the smallest inequalities and the sharpness of the flaking are preserved, and are handsomely covered by the patina as well as by this smoothness. It would be a misnomer to call this smoothness a

*It is at present impossible to correlate the drift of these points with the drift epochs of America. But the deep alteration of the Thetford chert seems to require that the gravels in which it was found belong to the Kansas epoch rather than the Wisconsin; though it may have long antedated even the Kansan.

"polish," if by that is meant an artificial frictional effect. It may be a "polish" if it be allowed that the polishing agent had no grit, and was nothing more abrasive than wind and rain and sunshine. The speci-



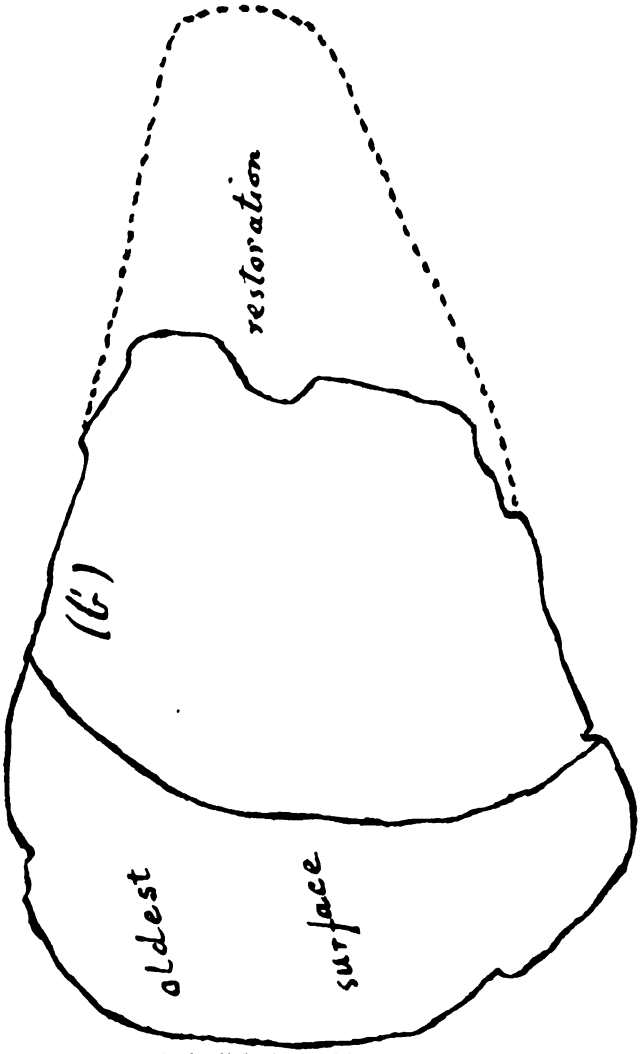
Paleolith from Thetford, Eng.

PALEOLITH FROM FEUARDENT, FRANCE.

PLATE II.

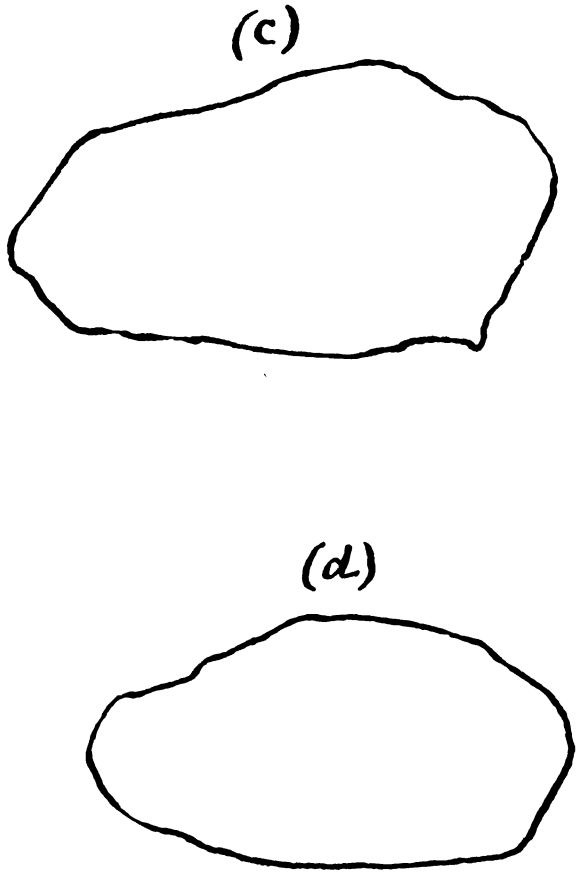
PALEOLITH FROM THETFORD, ENG. PAGES 13, 58.

men from England may also have had some experience of friction in the gravel with which it was associated, but that cannot be stated of the specimen from the Loire Bassin. (See Plates I and II).



Paleolith from Thetford, Eng.

3. Two specimens, chert "scrapers" or flakes, No. 2230 of the Brower collection register, and No. 99553 of the Smithsonian Institution, from the cavern of Le Moustier, Vezere valley, France.



From the Cavern of Le Moustier.

Each of these is a single flake, but (c) was preceded by other flakes from the same core. They show but little secondary chipping, and probably all of the fine secondary chipping was produced by use as implements, since it is restricted to the long, sharp edges, or sides. Of these, that marked (c) has a few very fine vermicular, tubes or coatings, apparently calcareous, and some scattering spots of incrustation exactly comparable with those found by the writer adherent on some flints taken from the McKinstry mounds in northern Minnesota, and described by him in "Aborigines of Minnesota" p. 371, probably the forms of maggots accompanying the decay of flesh. That marked (d) has no incrustation. Both of them are gray in color, and nearly as fresh as when they were first made. More than one-half of one side of (d) shows however, the original old surface which was the outside of the nodule from which the flake was taken. This surface is decayed to the depth of about an eighth of an inch and turned much lighter colored. In general, however, the flaked surfaces of these specimens show no patina nor smoothing comparable with the same found on the drift artifacts. Not only does their known history but also their present condition show that they are much more recent in origin than the above noted drift specimens. Yet they are "prehistoric," in Europe; and they serve to establish the fact that artificial cherts, at least when in caverns, do not acquire a marked patina with the lapse of several thousand years, and do not show any kind of decay. And so far as the cave of Le Moustier is concerned, these specimens tend to show that its inhabitants were not

contemporary with the men of the river artifacts, but were much later. Still, according to John Evans in his "Ancient stone implements and weapons of Great Britain," p. 447, the flint implements found in the Kent cavern at Torquay, England, in the cave earth below the stalagmite have "become nearly white and have a lustrous surface," proving greater age than these of Le Moustier, which may have come from nearer the surface than the bottom of the stratum carrying the human artifacts. A much-altered specimen described by Evans was so situated that it must have been the oldest of human relics found in that (Kent) cavern. It has the shape and about the size of the Thetford specimen above described, and this resemblance to the river-drift implements is noted by Evans (op. cit. p. 449). A worked flint flake is altered in an identical manner, coming from the cave earth beneath the stalagmite and associated with teeth of hyaena, bear and fox.

So far as can be determined from Evans' book referred to, all the flints from the "cave earth" are deeply altered, and patinated.

Above the stalagmite layer, which is referred to as an important separating datum, is a "black mould," and in it are found "polished" stone implements and others of bronze. The fauna of the cave earth, below the stalagmite, consists almost entirely of extinct species, cave lion, cave hyaena, cave bear, mammoth, woolly rhinoceros, horse, urus, Irish elk, bison, etc., but in the black mould are bones of modern species such as dog, short-horn ox, roe-deer, sheep, goat, pig and rabbit. It is evident that some great catastrophe in

nature had taken place after the formation of the cave-earth by which the great mammals had been exterminated or expelled and, after the catastrophe, had been succeeded by a fauna essentially modern, at least post-Glacial.

Now, not only are the cave-earth flints similar to those found in the river-drift, but the extinct mammal remains of the river-drift are entirely similar to those of the cave-earth showing a substantial cotemporaneity. The inference is plain that the cave earth was accumulated in pre-Glacial (Pleistocene) time and that in England, as in America, Pleistocene time was characterized by the prevalence of the mammoth and the lion and a large number of predaceous animals, which became extinct with the oncoming of the Glacial epoch.

Effect of the Ice Age.

The ice-age was a period of flooding, in the countries that lay south of the ice margin, and this flooding was not confined to the time of the retreat of the ice, as has sometimes been supposed, but was continuous with and dependent on the extension and existence of the ice. That is the same as stating that it was several thousand years in duration. It served to accumulate vast quantities of gravel in the valleys of all the streams that flowed southward, away from the ice, sweeping into them not only its own gravel product, but much of the surface debris which was scattered over the land beyond the ice margin prior to the ice

age, including of course human artifacts and the bones of the great Pleistocene mammals.*

The effect of the ice-age, in the caves, was the deposition of the stalagmite (and stalactite) which covers the cave-earth. The increased waters that flowed over the lands caused more rapid solution from the limestones and a corresponding increase of calcareous deposition in the caves. Man if he existed then retreated south during the ice-age, along with the Pleistocene animals, and in keeping with that migration there is an absence of artifacts and animal remains in the stalagmite, or at least a remarkable dearth of signs of organic existence. "It seems to indicate a vast period of time during which the cavern (Kent's) was almost entirely unfrequented by man or beast."

The human implements in the cave-earth, therefore *were formed* at a date almost coeval with pre-Glacial time and contemporary with the formation of those that are now found in the river-gravels. Those found in the river-gravels were mingled with the Glacial gravels about cotemporary with the ice age when the ice existed further north and maintained a high stage of water in all the valleys. Being in the river gravels does not prove that they date from river-gravel time, any more than it does for the unworked cherts with which they are associated. The present pose of the cave earth artifacts probably in all cases antedates that of the river-gravel artifacts, although their origination was probably synchronous, for at the date of the formation of the gravels both man and the animals

*The statements in this discussion of the ice-age are based on the assumption that there was a single ice age, or epoch, which was the prevalent idea in England.

whose bones are found in the caves had either been exterminated or had migrated to southern latitudes. *The accumulation* of the artifacts in the gravel was accomplished while the stalagmite was being formed over the layer of cave-earth in the caverns. Thus:—

River Gravel	Caverns.
1. Pleistocene time, deeply excavated valleys, fauna of large animals, including man with his artifacts.	1. Pleistocene time, formation of cave earth. Man inhabiting caves, leaving bones of animals and human artifacts.
2. Glacial conditions, expulsion or extermination of the animal species, formation of river gravels with their artifacts.	2. Growth of stalagmite in the caverns, covering the cave earth.
3. Post Glacial conditions. Advent of present fauna, excavation of the present valleys through the layer of river gravel, forming the terraces.	3. In-wash of soil and formation of the "black band" overlying the stalagmite, with bones of recent animals.

While the above expresses the general succession of the main events, there were minor fluctuations. Sometimes the caves were modified in form, and enlarged, or partly filled with drift deposits through the action of the abundant waters of stage 2 and sometimes subordinate later stalagmite layers were formed, covering more or less of the floor. But in general there has been such a desiccation of the lands, since the Glacial period, that the growth of stalagmite has been very slow. There is sometimes a suggestion of a succession of Glacial epochs or Glacial stages in the occurrence of stalagmite layers of slightly different dates.

Evans says (*Ancient Stone implements of Great Britain*, p. 575): "The genuine specimens from the beds of river-drift almost, but not quite, invariably, present some one or more of the following characteristics:

glossiness of surface, dendritic markings, calcareous incrustations and discoloration, varying, of course with the nature of the beds in which they have lain. The angles are often somewhat smoothed, even if not distinctly water-worn; and when, as happens in some rare cases, the flint has remained unaltered in color, and without presenting in a marked manner any of the characteristics above specified, its surface will, on close examination, be found dotted over at intervals with bright glossy spots, probably those at which for ages it has been in contact with other stones. The glossiness of surface so frequent in these implements appears to be partly due to mechanical, and partly to chemical causes. The polishing effect of the friction of sand on flints in the bed of a river, or even when lying on the surface of the ground, is well known; and the brilliantly polished flakes not unfrequently found in the bed of the Seine, at Paris, and those from the sandy heaths of Norfolk and Suffolk, afford examples of the results of this friction since Neolithic times. In the Paleolithic implements, however, the gloss which so frequently accompanies a structural alteration in the surface of the flint seems due to the same chemical cause which has produced the alteration in the structure; and this cause as I have already remarked, appears to have been the infiltration of water partially dissolving the body of the flint." Of these characters Evans regards as most reliable the "alteration in the structure of the flint which has taken place over the greater part, if not the whole, of its surface, and the discoloration it has undergone." In England, according to descriptions given by Evans,

the color change consists of the acquirement of some yellowish, buff, or brown color, due to the penetration of ferriferous waters from the surrounding gravels. When these artifacts are found in "red marl," or at no great depth from the surface, where surface waters could carry carbonic acid, "they frequently become white," by the solution and removal of the coloring elements.

The characters dwelt upon by Evans are well exemplified by the Paleoliths of Kansas. Not all of the characters can be found on all the Kansas specimens, but they are all found in the collection. The most rare is the manganese sprinkling. The most pronounced are the smoothness of the surface and the change of color. See plates I and II.

[See supplemental note p. 44.]

2. THEY HAVE BEEN SECONDARILY CHIPPED BY LATER PEOPLE.

A priori, it may be stated that if there were a pre-Glacial people that produced coarsely chipped artifacts, a later people who needed chert for their implements would resort to the same chert deposits if they had not been covered by the Glacial drift. Such seems to have been the case at Quivira, and it seems also that the later people availed themselves of the coarse chips and rude implements of their predecessors. By how many successive peoples the chert deposits of Kansas were visited and quarried, it is impossible to state, or to surmise, but the differently weathered surfaces, when adjusted with the different degrees of culture as indicated by the absence of some kinds of artifacts

or with the prevalence of others of higher type, seem to denote at least four successive peoples as responsible for the artifacts of the Kansas valley. These four stages of culture were separated by long intervals of time, and these intervals are to be stated by thousands and probably by tens of thousands of years. It is hence possible that by reason of wars the successive peoples, (or tribes) were more numerous than the culture stages.

Character of the Paleolithic Artifacts.

The oldest *Paleolithic* artizan seems to have been satisfied, in the main, with the acquirement of an edge suitable for cutting, without much concern as to the shape of the piece. This is evinced by the prevalence of forms which, while possessing such edges, yet have no secondary chipping or shaping denoting any further purpose. Such edges are battered by use, and not by a secondary shaping designed to give a purposed outline to the implement. This is evident from the facts, that where the battered edges occur there is no perceptible alteration of general outline, that it occurs when the edges are straight without battering, and on projecting angles which, had the purpose been to bring the piece into desired shape, could easily have been further battered. Such specimens are fairly represented by the large pieces shown in Plates III and IV. These are two of the larger specimens in the collection. It can easily be seen, especially on plate IV, that the secondary battering had not the purpose to bring the edge into conformity with the general outline. The small end of the implement

probably was grasped and was employed as a handle, resulting in a rough and pronounced battering seen at the lower left-hand end.

But while the acquirement of an edge was the fundamental purpose, it is also true that there was a distinct tendency to bring the specimen into an oval or ovate-oblong shape, resulting in implements whose shape was like those seen in plate VII. These have been called "leaves," or "turtles." The advantage of these seems to consist in having a greater amount of cutting edge. Here also can be seen not only a battering due to use but also a battering which was designed to bring the specimens into the conventional shape. The collection contains a large number of such specimens, even more than of those like the forms seen in plates III and IV. They are often broken so as to show only one half. (Plate VII).

Besides the "turtles" one other designed form is also seen as a doubtful Paleolithic implement. It is shown on plate VI, numbered 5219, and its form suggests its use as a tomahawk. It has been so described by Mr. Brower with illustrations in his books *Quivira* and *Harahey*. He shows that both extremities were sometimes reduced to a cutting edge and shaped alike, in which case he styled them "double tomahawks." Such implements have in part the glossy surface and alteration of color, characteristic of a Paleolithic "turtle," as well as the placial patina (f) and probably are nearly or quite as old as the "turtle." It may be seen, however, that the surfaces (in specimen No. 5219, in plate VI) enclosed by dotted lines were old when the implement was formed. They have a con-

choidal surface indicating an earlier chipping, and are more deeply changed in color to yellowish brown and probably in texture. Hence there is reason to suppose that this implement may not belong with the true Paleoliths—either that or that there was a stone age which was pre-Paleolithic.*

(*Note.* It is plainly only an arbitrary use of terms which would consign one or the other of these classes to the "Paleolithic" group, if by that consignment it were designed to express parallelism with the Paleolithic implements of Europe. It is the idea of the author that the term *Paleolithic*, used in this paper, expresses immediately pre-Glacial, i. e. pre-Kansan. There are older chipped artifacts in the Kansas valley, however, and while these are also actually pre-Glacial they can be distinguished as *Early Paleolithic*, and they may be parallel, substantially, with the European artifacts lately styled "eolithic.")

A similar distinction can be made in other figures of plate VI, viz.: in figure 5218 the dotted line separates a very old chipped surface, which is turned brown, from the rest, which latter has a glossy surface and a light-grayish, mottled, color and conchoidal fractures. The interior, as shown by fractures on the reverse side, is gray and blue-gray. The specimen numbered 5217 is divisible into two ages of chipping. That enclosed at the right lower corner is quite fresh compared to the rest. Specimen 5216 shows, so far as exhibited by the plate, only the very old and deeply stained (Early Paleolithic) surfaces described in the last. These oldest surfaces are however plainly due to some old chipping, as they show the characteristic conchoidal curves; but on the reverse side about one-

*On all the plates the word "Pre-Paleolithic" should be changed to Early Paleolithic. ,

third of the surface is of fresher chipping, yet showing a glossiness due apparently to Paleolithic age. Specimen No. 5220 exhibits only the weathering which is seen on the greater part of No. 5218. The right half of this figure is occupied by the altered scale which was next to the limestone matrix prior to the chipping. This scale is about one-third of an inch thick, the chert having been converted into a harsh, siliceous, nearly white rock by the loss of its coloring ingredient. Specimen 5221 is a part of an old flake. It is turned brown all over, but is somewhat mottled. Its edge has been used for cutting. It is not of the oldest Paleolithic, and may be even post-Glacial. On being broken it is found to be brown throughout, and has no superficial change of color, but it is nicely polished. This shows that *by exposure the first change is the acquirement of a polish or gloss.* Nos. 5222, 5223 and 5224 are to be classed, as to age with No. 5221, made from altered chert at first, and probably post-Kansan Glacial. No. 5223 on the reverse side has a remnant of an Early Paleolithic surface.

Besides the tendency toward the leaf or turtle shape, there is apparent also a tendency to a rectangular shape, but this is not so strong as the former. This gives rude implements that approximate toward the tomahawk, but also to squares, as illustrated in plate V.

In plate VII are shown four artifacts which may be taken as illustrations of the average Paleolithic implement as to size and form. Those in the top of the plate (No. 5198) show the patina described above as (b) and (e), the latter, however, only on the reverse

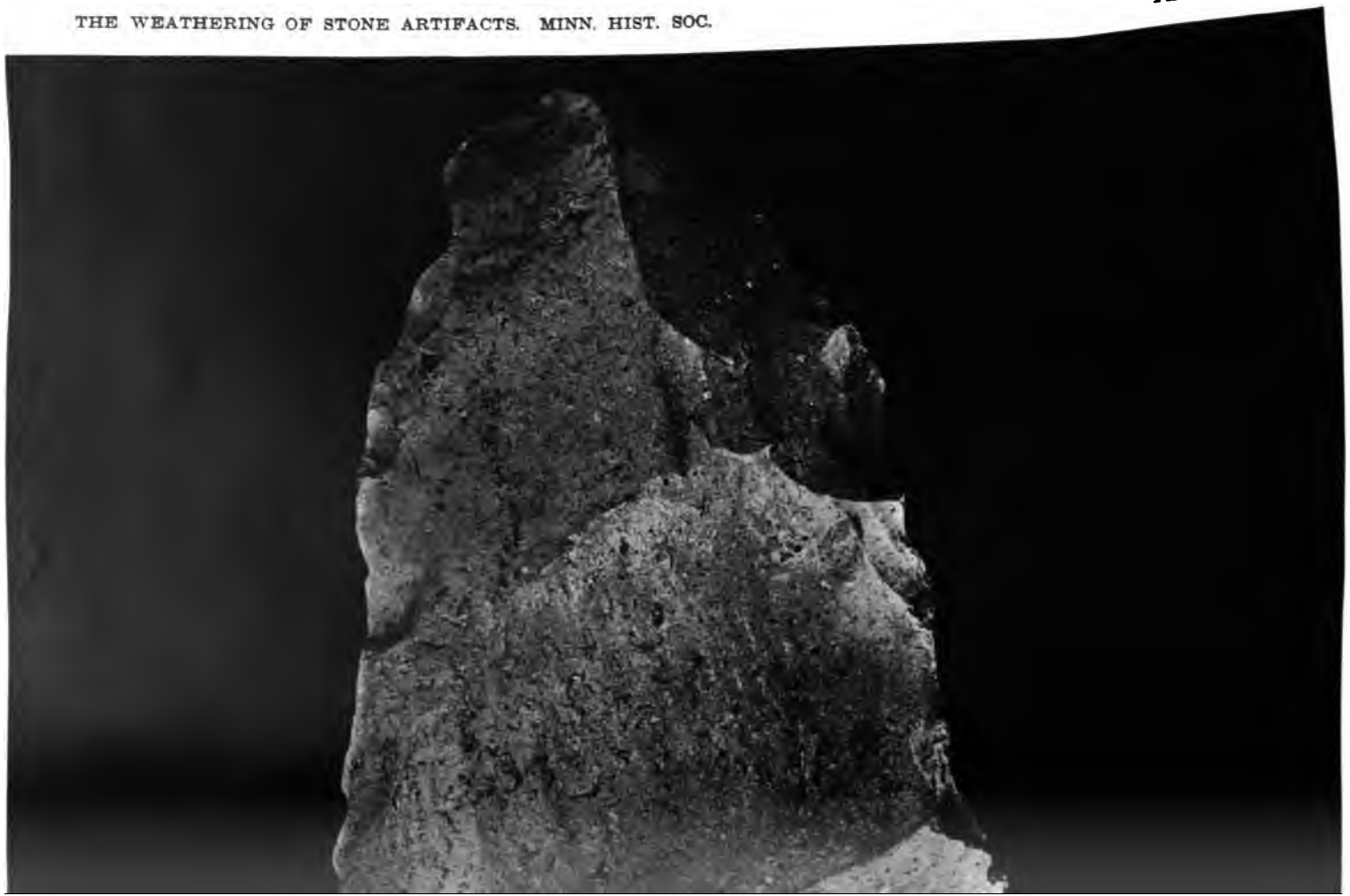
side which is also less polished. Their edges have been battered by use, their general outlines having been produced by the coarse chipping. There is also a sprinkling of black substance designated patina (d). This gathers preferably in small depressions and sheltered angles, and on the rougher surfaces. The objects figured at the bottom of the same plate show the same characters, but with a better glossiness and less of the other forms of patina. That figured at the lower right hand corner shows a large area of Early Paleolithic date, comparable as to date with that of No. 5216 in plate VI. It is nearly flat and may not be due to artificial chipping. It shows the patinae (a) and (e), the latter entirely hiding any polish that may have once existed. Patina (a) has the thickness of card-paper, and is cream white. It can be seen about the edge where it has been intersected by the later (Paleolithic) chipping.

Rechipping of old artifacts is shown also on plate VIII, but in this case both chippings are Paleolithic, the older being provisionally designated here as *pre-Paleolithic* i. e. Early Paleolithic. The specimen represented in the upper left hand corner of the plate (5226) shows two dates of chipping, at least two dates of old weathering, the older being brown and the younger yellowish, mottled with dark yellow and with dirty gray. That this was an old slab, or implement, before the Paleolithic chipping is indicated by the facts that (1) the older surfaces are inclined to each other as if they were due to a very ancient chipping, and (2) that on the reverse side some of the Early Paleolithic surface remains and extends down to the edge

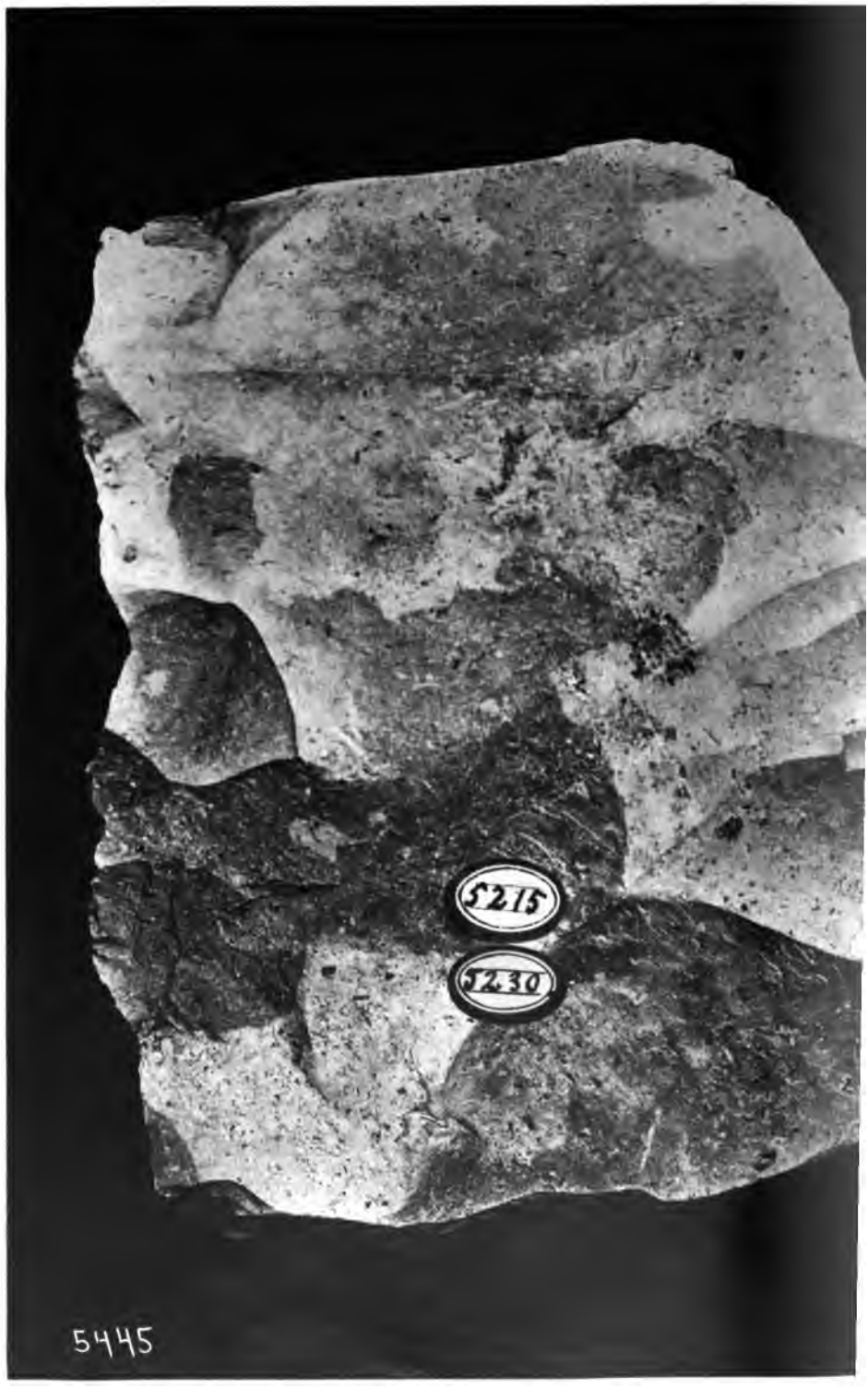
of the implement but showing three adjoining conchoidal facets. The specimen (5226) shown in the upper right hand corner shows, as indicated by the dotted line, a remnant of an Early Paleolithic surface, divided, in a similar manner, into two surfaces which approach each other at a broad angle and originally must have caused a characteristic intersection and a ridge. A trace of this old ridge remains, but the most of it has been destroyed by the later working. This specimen shows, at the bottom, a small Neolithic surface, also outlined by a dotted line, which may have been caused by the Indians, or by some other means. With the exception of this fresh surface the whole specimen is enclosed in a gloss due to Paleolithic age. The specimen in the lower left hand corner, (5230) having a roughly rectangular outline and a slight notching suggesting a tomahawk form, has a marked conchoidal remnant of Early Paleolithic fracture, as outlined by the dotted line. The existence of this lateral notch coincident with the Paleolithic character of this piece shows that the idea of *tomahawk*, as expressed in the shapes of some of the specimens, was not so late in its origin, as Neolithic time; yet there is an aspect of greater freshness in this specimen than in the most of those evidently Paleolithic, and it may be that there was a phase of stone art intermediate between the Paleolithic (as here already defined) and Neolithic, allowing for a culture which could be assigned to the age between the Kansas and the Wisconsin, namely the Buchanan stage. Perhaps the scraper idea also dates from the age between the Kansas and the Wisconsin. Still these tomahawk forms

sometimes show a Glacial patina, and are earlier than some ice epoch. The specimen in the center, below, (5114) shows three dates of chipping, numbered on the specimen (1), (2) and (3) respectively according to their ages. No. (1) occupies the most of the specimen. It is distinctly glossy and light-colored, and embraces curving and indulating fracture planes. The specimen was broken evidently from a large piece of the same date, since its reverse side has an ictus-bulb and conchoidal facet that shows the weathering of No. (2). On the side photographed there is less area of No. (2), but two patches can be seen. One is at the upper end, invisible in the photograph. No. (3) is confined to the larger end of the specimen and was a secondary chipping calculated to produce the mono-bevel of the Neolithic scraper, but the effort failed, or was abandoned, because of the poor quality of the chert at that end, being much rotted and probably a part of the matrix surface of the original nodule. These areas are outlined by the dotted lines, and for the present they may be distinguished conveniently (though perhaps not correctly) as Early Paleolithic, Paleolithic and Neolithic. The specimen illustrated in the lower right hand corner of plate VIII (5226) shows two dates of chipping, one Early Paleolithic and the other Paleolithic. Where the flake surfaces of the later chipping intersect those of the earlier, the thickness of the older weathering is shown by the white edge of the altered surface where it abuts on the later flaking. These two dates are outlined by dotted lines. They both show the undulations of a forced fracture.

PALEOLITH FROM THE KANSAS VALLEY. PAGES 26, 59.



PALEOLITH FROM THE KANSAS VALLEY. PAGES 26, 59.

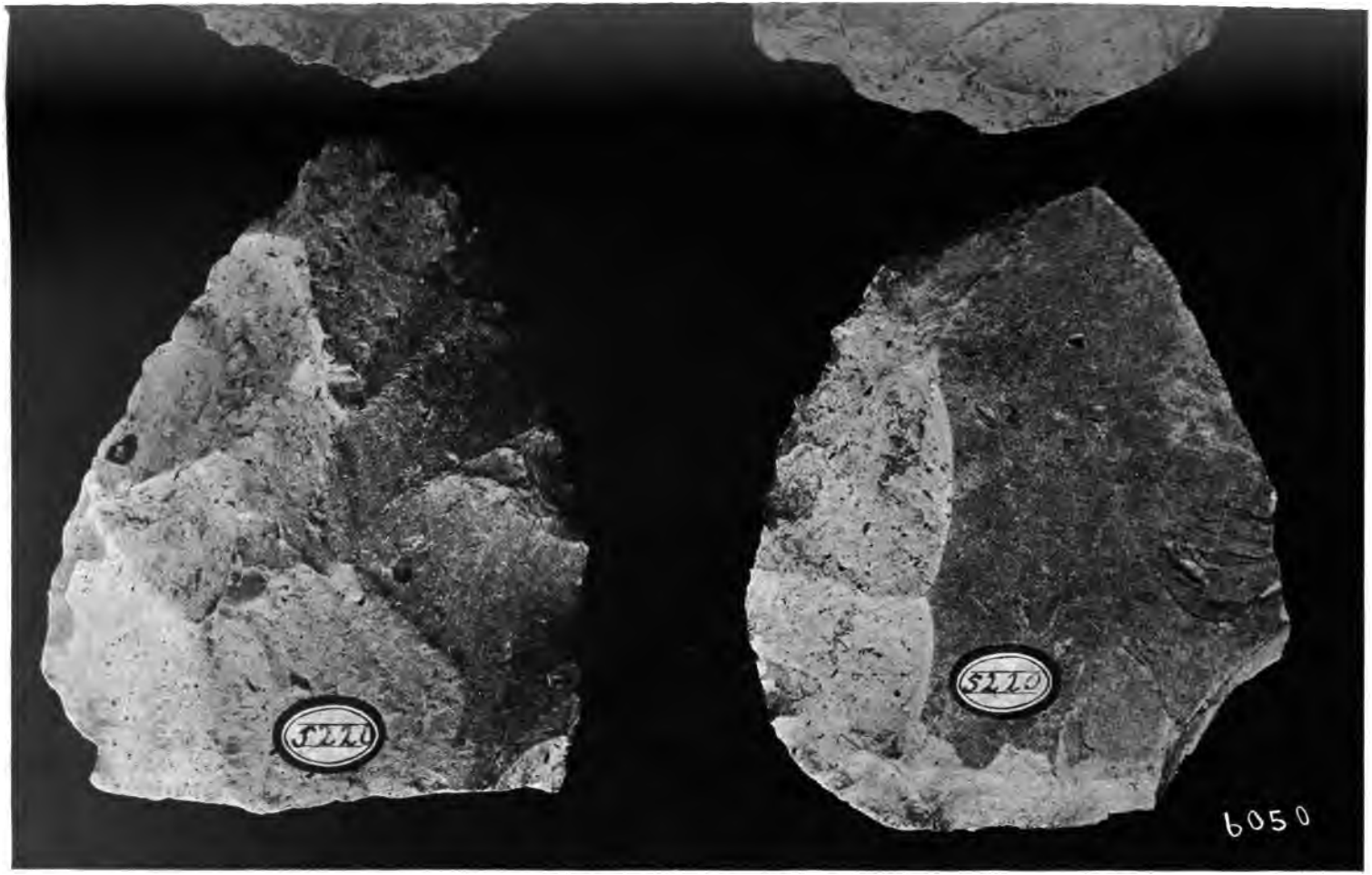


PALEOLITHIC

[C. PAGES 29, 60.

5222
5223
5224
5221
5220
5219

EARLY PALEOLITHS, PALEOLITHS AND PALEOLITHS RECHIPPED. PAGES 28, 60.



PALEOLITHS. PAGES 27, 29, 62.

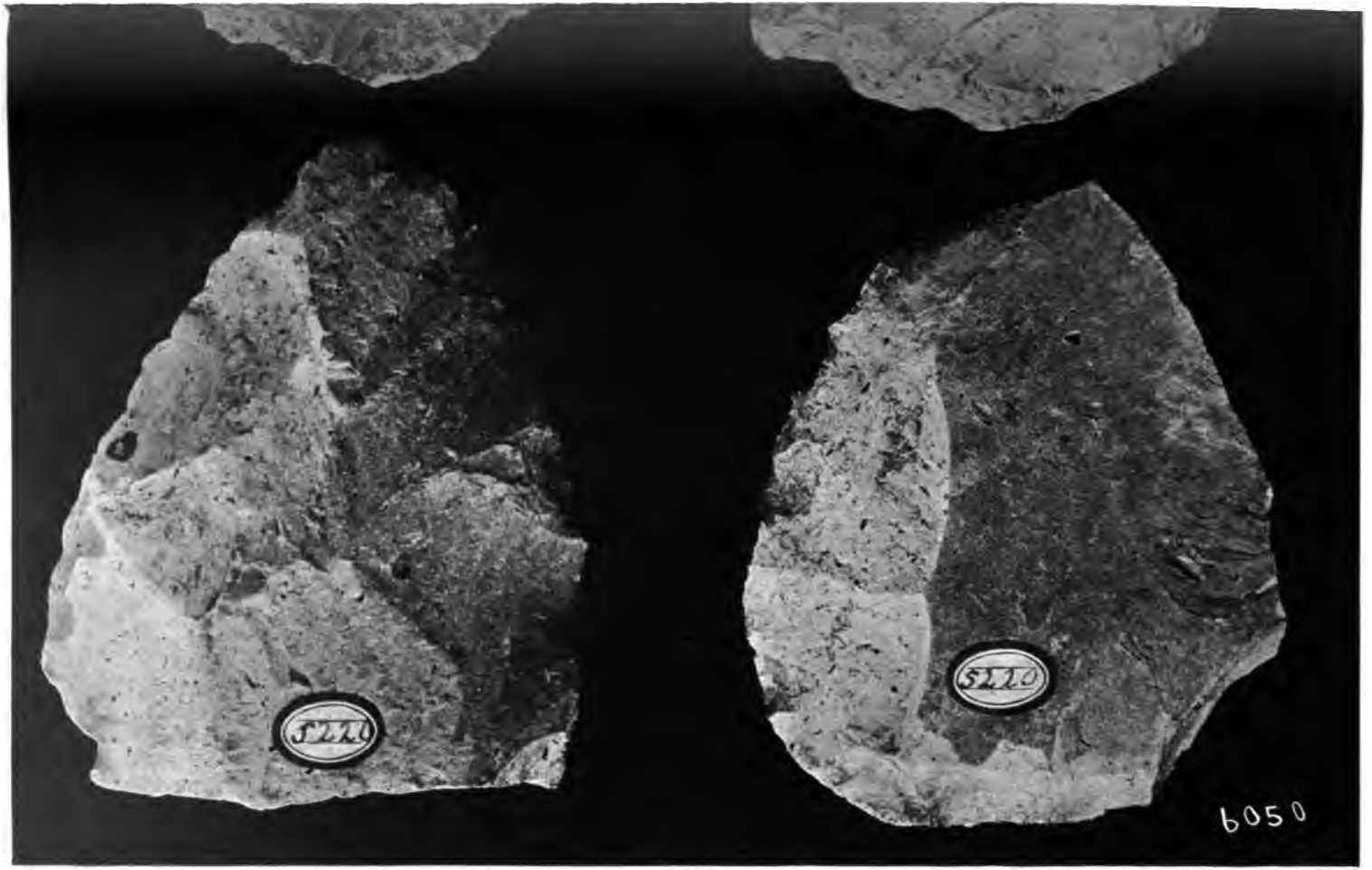
PALEOLITHIC

5225
5230

5222
5223
5224
5221
5220
5219

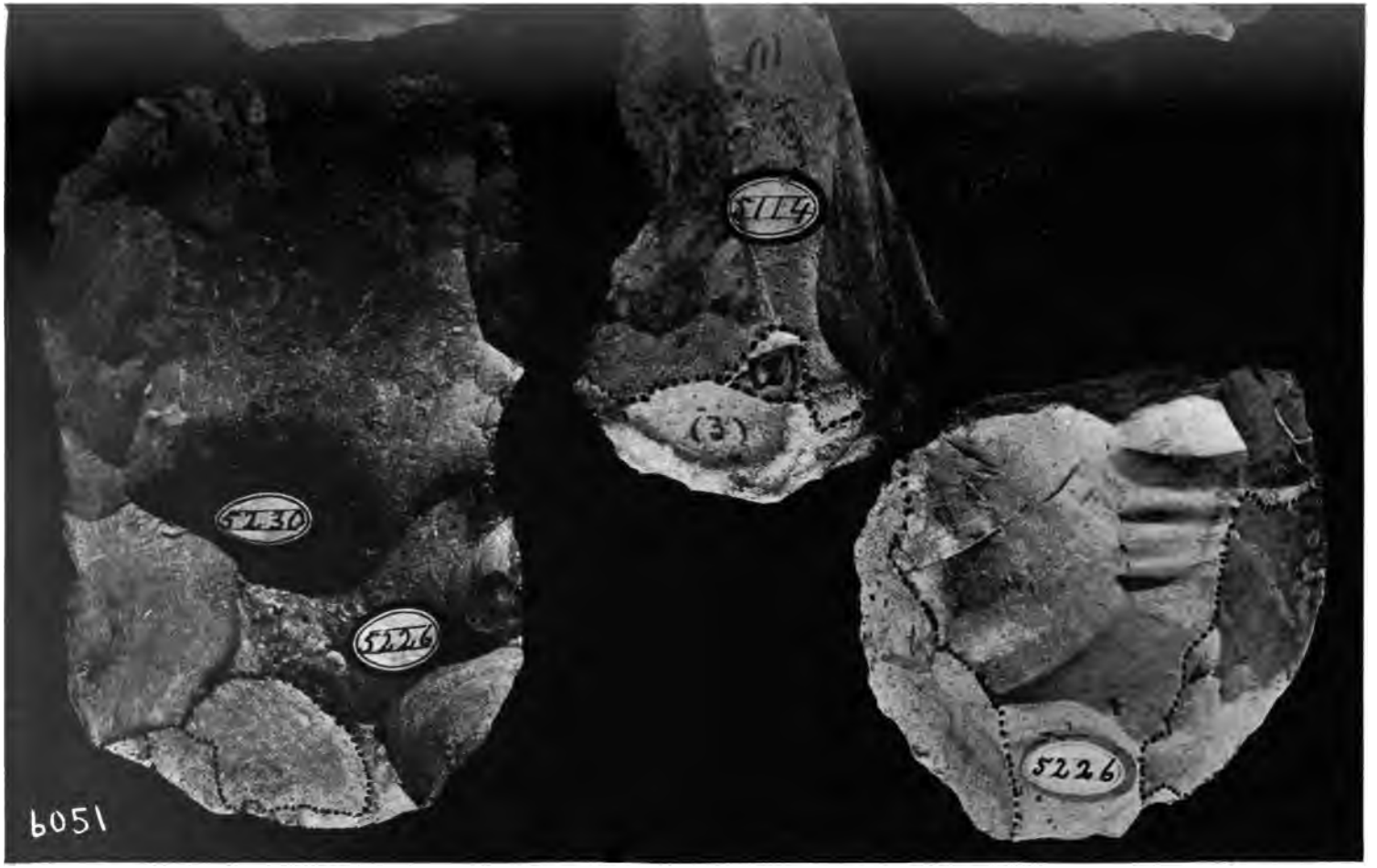
EARLY PALEOLITHS, PALEOLITHS AND PALEOLITHS RECHIPPED. PAGES 28, 60.

5T48
5T47



PALEOLITHS. PAGES 27, 29, 62.

5226
Paleo
Prepaleolithic
5226



TWO PALEOLITHIC DATES. PAGES 30, 62.

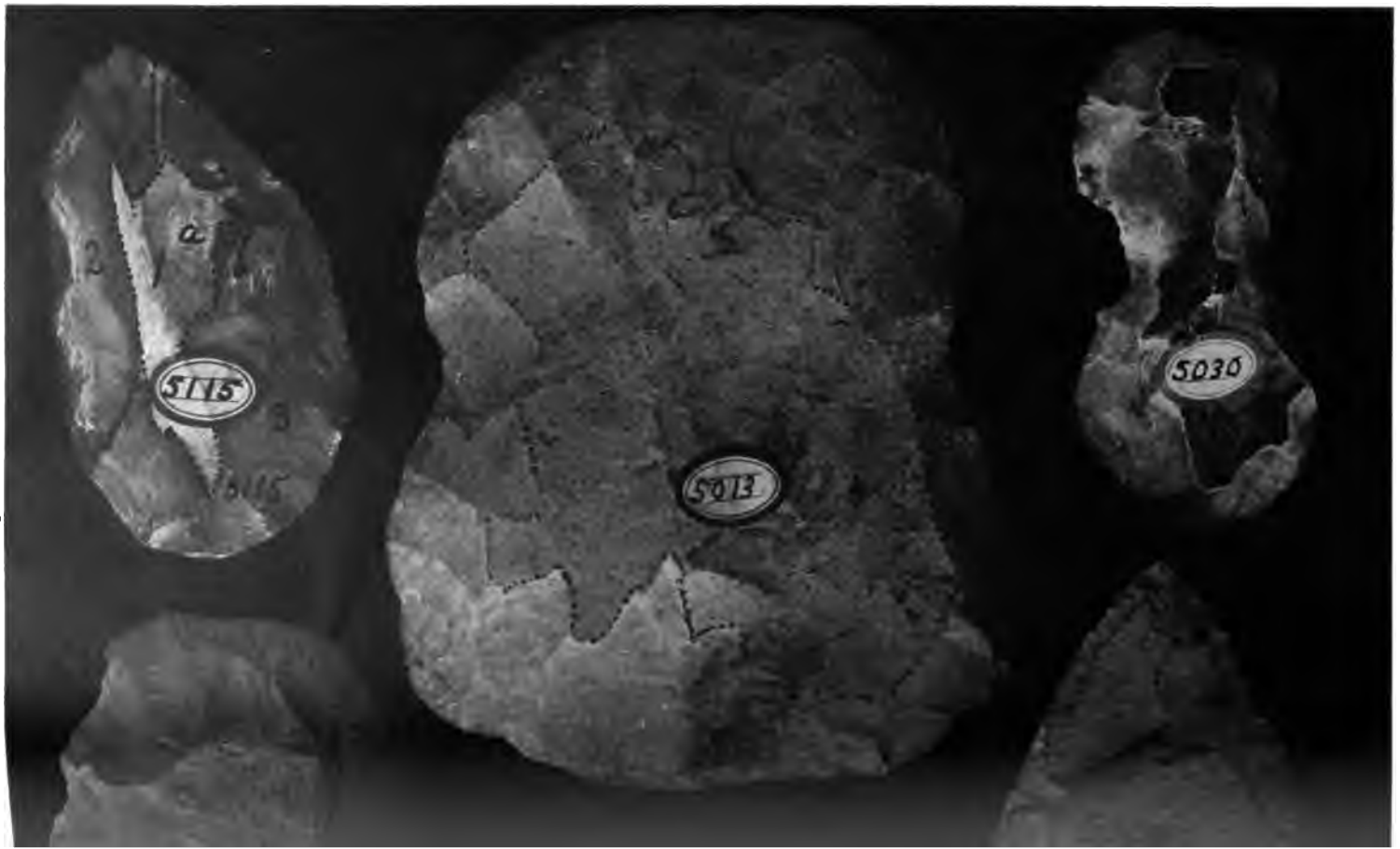
Other specimens might be selected to show the same contrasts in the weathering of the chipped surfaces of the same piece.

Plate IX is intended to show specimens that have had Paleolithic and Neolithic chipping, described as follows, beginning at the upper left hand corner. No. 5115 shows an Early Paleolithic area embracing the central part of the specimen. The Neolithic chipping is about the margin, especially on the right side. There is some doubt as to the rank of this secondary chipping especially along the left side, where most of it is glossy. The material is the same as that of No. 5221 of plate VI, and its age is equally uncertain. The contrast however between the two chippings is quite marked, regardless of their actual rank. The specimen in the center at the top (5013) shows the older chipped area outlined in the central part. The edge all around is perfectly chipped, and the other side of the specimen is almost wholly fresh. The notches on the sides of the specimen were made by the fresh chipping. The specimen in the upper right hand corner (5030), a small double scraper, nono-beveled at each end, shows a marked contrast between the old and the fresh chipping. The thickness of the Paleolithic patina is quite marked where the chippings come together, suggesting that the older surfaces may be Early Paleolithic. The specimen in the lower left hand corner (5227) shows two dates of chipping (even three dates), but they are not so strongly contrasted as in the last, and it is uncertain whether any of it can be considered Neolithic. This uncertainty does not exist in the case of the specimen represented in the

middle of the lower row, for the line separates areas that show distinctly different periods of weathering, that in the center being like that of the most of the specimens here classed as Paleolithic. Outside of that area the surface is unglossy, and is fractured by a multitude of small chippings which appear to have been made mainly by the use of the piece as a hammer. The specimen numbered 5008 is a notched "point," made from a Paleolithic chip by Neolithic work. The Paleolithic area shows the undulations of forced flaking, and is lighter colored than the Neolithic surfaces.

In plate X the figures show Early Paleolithic surfaces, with characteristic conchoidal chip-fractures. The larger specimen (5226) was chipped again by Paleolithic men, bringing out sharply the thickness of the Early Paleolithic alteration crust and its color. It is as thick as thick card paper, and its edge is almost white. The dark-colored surface at the top and along the right side is considered Paleolithic, but is not highly glossy. It is, however, in that respect like many of the Kansas Paleoliths. The other specimen (5227) while Early Paleolithic throughout the most of the exposed surface, was chipped by Neolithic man along the upper edge, as evinced by the fresh fracture surfaces. The Early Paleolithic weather-crust, or patina, has somewhat less thickness than seen in the last, and consists, not of a gloss, but of an alteration in color to a dirty white. The dark spots seen on the Early Paleolithic surface are caused by limonite deposits.

Plate XI shows a collection of artifacts of recent date, collected by Mr. Brower in the valley of Mill


5015
5013
5030

PALEOLITHS SHOWING EARLY PALEOLITHIC, NEOLITHIC AND EARLY NEOLITHIC CHIPPING. PAGES 33, 63.

Creek, in the area of the people called *Harahey* by him. The village sites that afford these more artistic and freshly chipped implements also afford implements and refuse of all of the foregoing types.

A large nmber representative of all the types were collected by Mr. Brower, running into the thousands. Usually the chipping on these artifacts is wholly recent and fresh and can be attributed to the Indians resident in the Kansas valley at the date of the visit of Coronado in 1541. Still there can be seen sometimes slight differences in the weathering, and sometimes on the same specimen, indicating that the Neolithic stone chipper chose his material from flakes or chips which were older. The first of this plate (5021) seen at the upper left-hand corner is unique in form in this locality as well as in the kind of chert, called Harahey knife by Mr. Brower, and the material must have come originally from some other locality.* It is fine-grained, siliceous and quite light-colored, with a faint suggestion of flesh-red, but has veinings and irregular deposits of light blue quartz. The next figure (5022) which is *canoe-shaped*, represents what Mr. Brower called a Quiviran knife. Although it is freshly formed, the chipping did not entirely remove an older surface, of which remnants appear on both sides. This older surface, however, is not characteristically Paleolithic. The next (5053) represents a handsome little tomahawk, chipped fresh all over. The tanged knife, or "point" (5094), shows also only fresh, or recent, chipping. The same statement can be made of

*Subsequently it was found that the Kansas chert is quite variable, in local and exceptional conditions, though having a type uniformity.

the next figure (5052), a chipped leaf, or knife, of an elongate and pointed, ovate outline. The barbed point (5080) is also wholly recent, but the character of the chert indicates that it may have been imported to the Kansas valley. The specimen figured by 5071 is freshly chipped at the notches and along one edge between the notch and the point, but elsewhere the surface is old, though not Paleolithic, having a shiny luster. The specimen was evidently a knife or a point prior to the latest chipping, and had a straight, edged base. It indicates a stage of chipping and of art between the Paleolith and the Neolith. The chert is of the native variety. Specimen 5031 might be called an imperfect scraper, as it shows one side nearly flat and a tendency toward mono-beveling at one end. Its edges, which have been roughened apparently by use, show the freshest chipping, prior to which it was a somewhat weathered flake. The chipping seen on No. 5035 is wholly fresh. This is a common form found in Mill Creek valley. In the case of No. 5025 a portion of the original surface of the piece from which the implement was made, can be seen on one side. The shape of this remnant, which runs to the extremity of the blunt point, indicates that this was an implement prior to the latest chipping. No. 5175, a large and otherwise typical, scraper, is problematical. It has but little fresh chipping, and such as there is, is confined to the mono-beveled edge; but the surface is everywhere shiny with age. This age is not great enough to warrant assigning the specimen to Paleolithic time, and such a reference would be negatived also by the fineness and completeness of the implement. It seems

to be neither recent nor Paleolithic, an intimation which is derived also from Nos. 5022 and 5071. The two specimens numbered 5024 are, in the main, freshly chipped, but the chipping about the notches and along some of the edges is later than some of the surface remote from the edges.* The same is true of those numbered 5060. These have evidently been used as knives rather than as arrow points, as the edges from the notch to the point are more or less dulled by use. No. 5057 was freshly made from a flake, and a portion of the original surface remains distinguishable from the chipping about the edges, but the latest chipping still is not so recent as that seen in the specimens figured at the top of the plate. No. 5061 illustrates the same truth, viz: that some of the recent artifacts show two chippings, the latest being, in this case, in notches above the ears, and in the notch in the base.

Probably the foregoing illustrations are sufficient to establish the second of the propositions already stated, viz: that the artifacts of the region show two or more dates of chipping. If full acceptance be given to the evidence so far as it indicates difference of age, it seems to be necessary to allow four dates of chipping, viz: Early Paleolithic, Paleolithic, Early Neolithic and Neolithic, which, for the present, may be assumed to be expressed as follows in terms of Glacial geology:

1. Early Paleolithic. Pleistocene (or Aftonian).
2. Paleolithic. Pre-Kansan or Aftonian.
3. Early Neolithic, Buchanan.
4. Neolithic. Peorian and Recent. (i. e. Post Wisconsin).

*"These would generally be considered as broken points, rechipped at the end to make scrapers"—**F. W. Putnam.**

There is no question of the existence of these stages in the weathering of these Kansas artifacts. If the chert were not derived from the same place, and if it were not of essentially uniform characters as to color and hardness, and if the specimens compared were obtained from distant or different localities, the distinctions mentioned would be less likely to be valid. The area is restricted to a portion of the Kansas valley. The foregoing collocation of these differences with the stages of the Pleistocene and of Glacial time, based on the determinations of the Iowa geological survey, is entirely provisional.

3. LOCATION OF THESE ARTIFACTS.

These observations are confined to a small tract in the north-east central Kansas lying south from the southern limit of the drift at that place. There is a copious morainic accumulation of northern drift in northeastern Kansas extending nearly to the Kansas valley at this place, and crossing it further east, extending into Missouri south of Kansas City. This carries many large boulders of granite and red quartzyte derived from Minnesota. Such a morainic accumulation, at the time the ice was present would have dammed the Kansas river and ponded it back so as to flood a portion of the country, and hence would have formed a layer of loess-like clay which would have buried numerous artifacts of earlier origin, and it is not impossible that the Kansas valley at this place was choked with glacial gravel and sand, which also would serve to cover and conceal Early Paleolithic and Paleolithic work. The fact that the ice

limit was near adjacent toward the north and northeast from this small area in Kansas is well known and is indicated on Wright's map of the Glacial geology of the United States and Southern Canada (*Ice Age in North America*, 5th Edition). Whether the lacustrine or alluvial deposits cotemporary with this extension of the ice covered the limestone plateau containing the chert beds is not known, but it is evident that if this upland was so covered the limestone, with its cherty beds, has since been uncovered. The writer at this date has not seen the locality, and has to depend on the descriptions of Mr. Brower and Judge Keagy. (The accompanying map of northeastern Kansas was made since this was written and shows that the limestone area was exempted).

4. RELATION TO THE GLACIAL DRIFT.

That the chert-bearing limestone of the upland, specially designated by Mr. Brower as the habitat of the Quivirans, and specially marked by the prevalence of the Paleolithic implements and by the absence of Neolithic handiwork, was not disturbed by the ice itself, is evident from the absence of Glacial drift (boulders and till) from the region as well as by the concentration of these artifacts. Had the ice moved over these loose artifacts they would have been scattered and distributed confusedly amongst Glacial deposits of till or of gravel and sand.

5. AQUEOUS DEPOSITS OF THE LOWER KANSAS VALLEY.

That the Kansas valley in general at this place was flooded, is evident from the occurrence of aqueous de-

posits at considerable elevations above the present high-water mark. It is somewhat difficult to assign these aqueous deposits unequivocally to the respective Glacial epochs. The lower lying gravel and sand may be of the date of the Kansas epoch, and certain loess-like or clayey beds, overlying such gravel and sand, may date from the Iowan. Early Paleolithic and Paleolithic artifacts only would be expected in the former, while in the latter might also be found Early Neolithic. The habitat of the Harahey was therefore, so far as it was within the valley, upon the aqueous deposits of one or more ice-epochs, and so far as it extended beyond the valley toward the east it was upon Glacial drift. If the same people or any people cotemporary with them, occupied any part of Kansas further west or southwest, they were beyond the ice limit, and they may have come into contact with pre-Glacial artifacts.

6. MINGLING OF PALEOLITHIC AND NEOLITHIC ARTIFACTS.

The sixth proposition affirms that along the valleys, when not buried, the oldest artifacts are mixed on the surface with the newest. This is illustrated by the findings of Mr. Brower and of Judge Keagy. The collections of the Minnesota Historical Society, derived from the Mill Creek valley, embrace the oldest and the newest of human stone artifacts. It shows that the Harahey carried the rude artifacts of the upland to their village sites and there rechipped them into finer forms, resulting in the frequent preservation of some of the Paleolithic surfaces on the finished Neolithic

implements. If the statement of Mr. Brower be accepted unqualifiedly, to the effect that the finished Neolithic implements are never found in the region of the rude implements, (i. e. in the region of the Quivirans), it would follow that in all cases the modern stone workers carried the rude artifacts to the valley before re-working them. But *a priori* it would be reasonable to suppose that occasionally some of the Neolithic men would have done some of their re-chipping on the spot where the material was found, and perhaps had there also some of their village sites, or at least some temporary camps. It is possible that further search in the area of the Quivirans, as defined by Mr. Brower, will reveal more or less of the working which Mr. Brower supposed was characteristic of the Haraheyans.* Therefore it is probable that there cannot be made any reliable geographic definition of the present distribution of these kinds of artifacts. The safest distinctions are those based on type of culture and extent of weathering.

7. The seventh proposition has been anticipated in the discussion of the second.

II. CULTURAL STAGES OF STONE CHIPPING CORRELATED WITH GLACIAL STAGES.

It has already been remarked that the man of Paleolithic time (and hence of Early Paleolithic), was satisfied *with the acquirement of an edge.* With that he

*It may also be remarked that Mr. Brower's illustrations of "Quiviran" implements include several types of Neolithic implements, especially some found by him in the Elliott (Quiviran) village site.

could do the roughest and simplest cutting by using the implement in his hand, without a withed handle. Such edges he often found ready to his hand, made by nature, and very many show by their battered angles that they have been used as knives or primitive axes, without any artificial chipping, illustrating the "Protolithic" stone age of McGee, (see Am. Anth. IX, p. 318, 1896). Amongst the hundreds of Paleoliths gathered in Kansas, there is no intimation of an arrow-point, nor of a scraper, nor of a finished knife or blade, nor of a pestle and mortar, nor of a grooved hammer, nor a drill. The artifacts, so far as appears at present, warrant the inference only of the rudest kind of human life, in which the exigencies of scanty food and little or no clothing were connected with those of the most comfortless kind of existence. We have no right therefore to assume the presence of the buffalo—nay, we are debarred from such a presumption, for in the presence of such an animal, so inoffensive, so easily killed and so productive of both food and raiment, Paleolithic man would have given to his stone artifacts some of the features that would have aided him in its capture, if not in the fabrication of useful articles from the hides and bones. His physical condition is well described by Mr. Brower in the words which he applied to the Quivirans:

"As Nature's children turned loose upon the plains of Kansas, with nothing whatever except their two hands and a savage intellect, urged on by necessities engendered by their hardships and by exposure; with one stone they chipped another to a fractured edge, sallied forth, lived and prospered." *Quivira*, p. 22.

There is, however, a class of implements which by their weathering approach toward the Paleolith, which are excluded by the terms of the last paragraph. It is as yet questionable where they belong. They embrace some long, well-made knives, some scrapers and the articles that have been styled tomahawks. They show too much delicate manipulation to warrant putting them with true Paleoliths, as understood by the writer. One of the scrapers has been included in plate XI, (5175) among the Neolithic artifacts, but with some doubt and qualification. There are quite a number of these. One of the knives and one of the tomahawks (5015) are partially coated with a calcareous scale, which is taken as indication that they have been buried in some drift deposit for a long time. At present the only way apparent by which to adjust the culture with Glacial history is to refer these shiny implements to an Early Neolithic period, the Buchanan(?), and thereby to presume they have been embraced in a calcareous loess belonging perhaps to the Iowan ice epoch. According to this there was a large advance in skill between the Paleolithic and the Early Neolithic. The idea of a tomahawk, the idea of a scraper and that of a long chert knife or blade, useful in many ways, were evolved, or at least existed, in Early Neolithic time, and that would, perhaps, warrant the presumption that the buffalo flourished on the plains in the Buchanan(?) inter-Glacial epoch.

It may be possible, in the future, to determine approximately when the stone arrow point was introduced, invloving a knowledge of the bow. At present there is not enough known of the consecutive steps of

progressive culture in Peorian and Recent time to warrant an attempt to fix its introduction further than to say that it was a Neolithic, or Early Neolithic, step, probably the latter. Subsequent to that came the fabrication of numerous polished stone articles characteristic of the early days of the present Indian.

Feb. 13, 1912.

Supplemental Note.

The argument of the foregoing chapter is based on the fact, (which is well known by geologists) that siliceous rocks, such as quartzyte, jaspilyte, flint and chert, are practically indestructible under atmospheric agents. The boulders of red quartzyte found near Topeka, in the Kansan moraine, are entirely intact, whereas those of granite can be crushed in the hand. Therefore chipped chert whenever it has a weather-scale of decay must be older than the Kansan moraine.

Aug. 15, 1912.

III. WHAT WERE THE TRIBES MET IN THE KANSAN VALLEY BY CORONADO IN 1541?

It is manifest, from the chronicles of the Coronado expedition, that there were two tribes or sub-tribes with whom Coronado had intercourse. It is also plain that their places of habitation were not far separate. They spoke substantially the same language. The guide of Coronado (Ysopete) acted as spokesman when Coronado first encountered the people of Quivira, and as interpreter when the two people came together to a conference with Coronado. It is also stated that the guides were both from Harahey. The

statement that these tribes were at war "with one another," is based plainly on a misunderstanding of the original, as it is inconsistent with all other facts which appertain to the relations of these two tribes. The expression can be understood by supposing that the words "these tribes" included all the tribes (the Querechos and the Teyas) with whom Coronado had met since he left Mexico. The circumstances of the death of missionary Padilla are given differently by different chroniclers. One account states that he was slain by the Haraheyans because of jealousy, when he attempted to carry the blessings that he had bestowed on them to their enemies, and the other that while en route to another tribe his party was attacked by hostile warriors and all were put to flight, Padilla submitting to death that the rest might escape.* The latter is far more reasonable and probable, and points to a state of war existing between the Haraheyans and some other tribe living further east. This hostile tribe was probably one of the stock of the Dakota, the Osage or the Kansas, with greater probability of the Kansas, since at a later date, after the Wichita had left the valley, the Kansas are known to have occupied the Kansas valley, with their central village on the Big Blue river, near its junction with the Kansas river.

In reviewing historic authorities and old maps Mr. Brower observes that Quivira is shown, not as a village, but as a province containing several villages. "The Spaniards under Coronado spent twenty-five days exploring the province of Quivira in all direc-

*Jaramillo also says that Padilla was slain by members of his own party, i. e. by some Indians that were with him as "lay servants".

tions before they retired in the direction from whence they came." In that explored area must have been included the habitat of the Haraheyans, and there is no evidence whatever of a state of war. All the facts indicate peaceful relations, and require that the Quivira and the Haraheyans were neighboring sub-tribes of the same stock. It has been shown, furthermore, by Mr. F. W. Hodge that the Quivira were Wichita-Caddo (*Harahey*, p. 68). Coronado sent a summons "to the governor of Harahey and Quivira", which shows that he understood that the people were closely allied and that the Haraheyans must have been also of the Caddoan stock. Mr. Hodge also has shown that the Harahey people were Pawnee, and adopts the suggestion of George Bird Grinnell that they were of that particular tribe of the Pawnee that were known then as *Ariki*, and later as *Arikara*, the same that for many years were closely associated with the Mandan on the upper Missouri in North Dakota, and this determination can hardly be questioned. They differed from the Wichita in dialect, and in the manner of dressing their hair, comparable to the description given by the chroniclers of the Coronado journey. The name "Harahey" could, perhaps, by such confusion and corruption as are not uncommon amongst modern writers of Indian names, be derived from the old name of the Arikara (*Ariki*) with less violence to the aboriginal vocalization than from any name borne by any neighboring Dakota tribe. It is further historically probable that the Arikara were still with their linguistic kin (*Skidi*) in 1541; and it is more likely that the Wichita Caddo, in answer to the question *what was*

next east from them, would mention their kin than an enemy. Again there is some significance in the fact that sometimes the two tribes are referred to as if they were one people, one part living but little removed from the other, and at other times referred to as two peoples. Such double significance could hardly have taken place if one were Caddoan and the other Dakotan.

The two cotemporary people therefore were of the same stock (Caddo), and must have been of identical culture, and neither of them could have been the fabricators of the implements which denote the rude and savage life mistakenly ascribed by Mr. Brower to the Quivira. They were both undistinguishable, in every respect, from the historic aborigines of the region. But the fabricators of the rude implements (though now more or less mingled with implements of higher culture) were much ruder and more savage, destitute of most of the simple utensils which characterized the former, without pottery, without earth houses, without stone vessels of any kind, with slight use of fire, a wild and barbarous race, dressed in skins and furs or in such garments as they constructed from a scant supply of flax and from skins which they sewed with sinew and needles of bone, using the extensive chert deposits of the region for rude axes and perhaps tomahawks, and grinding their food in flat metates made of boulders. "Nature's children turned loose upon the plains of Kansas, with nothing whatsoever except their two hands and a savage intellect, urged on by necessities engendered by their hardships and by exposure, with one stone they chipped another to

a fractured edge, sallied forth, lived and prospered." *Quivira*, p. 22. These contrasts of culture were further evidenced by the coarseness of the chipping which marked the implements of the ruder people, compared with that of the stone artifacts of the Caddo of history. It seems impossible that two aboriginal peoples thus different could live cotemporaneously in adjacent regions, in peace, for a period of time sufficient to satisfy the conditions of history. One would have exterminated or expelled the other as rapidly as aboriginal warfare could be made to do it. If these two peoples had been located in distant and different river basins, even then their differences would have led to the extirpation of one or the other, and the extension of the culture of the victor over the areas of both.

All these obstacles are obviated and a consistent succesion of ethnologic stages of culture becomes manifest by the relegation of the ruder people to a prehistoric age.

In the foregoing chapter evidence is given to show that the ruder people preceded the more cultured by a long interval of time, and that they were probably of the age which in Europe has been called Paleolithic, or Early Neolithic, or more likely both.

IV. EARLY MAN AND HIS COTEMPORARY FAUNA IN KANSAS.

The proofs of the existence of man in Kansas before and during the Glacial epoch, or epochs, as detailed in this article, are only renewed confirmations of the inferences that have been drawn from the discovery of

his skeletal remains and his stone artifacts in the loess of the Mississippi valley, which have been announced from time to time. These have been summarized by the writer in "Aborigines of Minnesota", 1911, pp. 2-23. If man's remains exist in the loess of the great valley, they can of course be there only adventitiously, and it would be reasonable to expect that on the land, where he must have spent his life and developed his activities, there would have been distributed, normally, more evident and more numerous traces of his habitation.* North from the limit of glaciation these traces were necessarily enveloped by the movements of the ice, and distributed, and often destroyed, by the resultant floods of water. He did not build, in the latitude of Kansas, any structures of stone that could withstand the destructive elements of the air. His habitations were rude and simple and have disappeared entirely. His domestic articles, when not of chert, have decayed; but he everywhere used the chert beds of the various geologic formations for the fabrication of implements needed for his daily existence, and these are practically indestructible, and they ought to be identifiable. So far as the writer is informed, however, this is the first attempt ever made in America to remove, because of differences of patination, a group of the stone artifacts of the country from the authorship of the historic Indian, or at least from the Indian

*The author considers the aqueous origin of the Mississippi loess, and hence that of the Missouri, as a whole, as demonstrated by its stratiform structure and its geographic distribution. It was the product of ages of rock-decay. Pleistocene and pre-Pleistocene, a gecst, which covered, and still covers, the most of the upland surface in Kansas and other states, swept into the valleys by the agencies mainly of the Iowan ice epoch.

of post-Glacial time, to pre-Glacial time, and to show the characters by which they can be distinguished.* Individual instances are not wanting in which, by reason of geological environments, isolated specimens have been shown to have been formed prior to the Wisconsin Glacial epoch, and one or two cases have been described in which the weathered condition of the artifacts indicated pre-Glacial date. The most important of these latter are (a) that of Claypole in 1896, "Human relics in the drift of Ohio", Am. Geol., XVIII, 302, and (b) that of the writer in 1909, "Possible pre-Glacial human remains about Washington, D. C.", Records of the Past, VII, 249.

In pursuance of a discussion of the *weathering of aboriginal stone artifacts*, it will be well to present a short review of the Glacial period, in order that the reader may apprehend the succession of the main climatic changes and the consequent physical changes in the surface of the country.

Previous to the advent of the first ice-sheet in Kansas, and throughout the most of the area of the United States, there was a long period of comparative quiet, during which it was possible for the existence and the multiplication of a characteristic fauna. This fauna embraced numerous large mammals which are now extinct.

According to Professor J. A. Udden, in the American Geologist, Vol. VII, p. 340, "*The Megalonyx beds in*

*The well-known work of the pioneer, Abbott, in the Delaware valley, and of his successor, Volk, under the auspices of the Peabody Museum of Cambridge, though mainly based on a study of the river gravels and sands, differentiated two types of artifacts and two peoples, prior to the Delaware Indians.

Kansas," pebbles of crystalline rock and quartz are found in a gravel deposit in McPherson county, Kansas. There are also certain detached masses of Cretaceous in the overyling strata which he considers to have been brought to their present position by floating ice. These deposits lie in a great north-south trough which cuts across the main east-west watershed of the state, uniting the valley of the Kansas with that of the Arkansas, which apparently drained an old lake several miles in extent extending over the valley of the Smoky Hill river, which had an overflow discharge southward into the valley of the Little Arkansas. This lake, if not a late Tertiary lake, may be ascribed to an ice sheet which dammed the Kansas and Smoky Hill valleys and diverted the drainage of Northwestern Kansas southward into the Arkansas valley. This "pre-Kansan" Glacial lake, which has never been named, and the sediments which it formed in this trough, are, apparently, indications of a drift epoch older than that whose terminal moraine is outlined on the accompanying plate-map. In the gravel at the bottom of this old trough Prof. Udden found fossil bones of Megalonyx and Equus.* A similar assemblage of fossils has been described by Calvin in Iowa, and referred by him to the Aftonian inter-glacial age. (Geol. Soc. Am., Vol. XX, 1909; Vol. XXII, 1911 and Iowa Geol. Sur. Vol. XX, 1910). This Atfonian inter-glacial epoch is that which immediately preceded the Kansan Glacial epoch, and followed the pre-Kansan. If

*These fossils having later been studied by Beede (Kan. Geol. Sur. vol. 2, p. 290) are found to comprise Megalonyx Leidyi, Equus major, Spherium striatum and sulcatum, Pisidium abditum, Anomodontia, Valvata and Gamarus.

these assignments of this fauna are correct as above given they seem not to be identical as to date. If man was a denizen of America at that date he was compelled to compete for existence with a horde of carnivores, and to share with them in the destruction of many herbivires. With the advent of the Glacial epoch (pre-Kansan) the physical conditions became more unfavorable, and so extreme that many species both of fauna and flora were forced to move southward, or were exterminated. Southward from the ice-margin, which probably extended into northeastern Kansas about as far as the mouth of the Salina river, the country was too cold for human comfort, even as far south as near the gulf of Mexico. It is not probable that man was expelled from the valley of the Mississippi southward from Kansas, nor from the shores of the gulf of Mexico. The river maintained an open channel in the midst of the ice-covered land for many hundreds of miles northward from the ice limit, and in many sheltered coves and small tributaries where these united with the Mississippi, the native fauna, especially those species that characterize now the latitude of Alaska and northern Canada, gathered in large numbers. And if man was then an inhabitant he was found in their company, and shared with them the fresh and cool air, the abundant fish and water fowl, and suffered also with them the depredations of the fiercer beasts. In summer he wandered over the country to the east and west of the Mississippi, and probably visited many wonted spots, including such as the chert deposits of Kansas, Mis-

souri, Illinois and Ohio, where he extracted material for the rough implements that he needed. The most of Kansas, although probably forested, was suitable for his roaming and hunting. Probably he had not yet the modern buffalo as a mentor for his movements, but there was a profusion of other animals which were useful for food, which were easily caught. He was not at all delicate in his taste, and devoured not only the most toothsome, but was well satisfied with anything that he could capture, not excepting insects, lizards and serpents. His most conspicuous companions were the mammoth, mastodon, giant beaver, megalonyx, moose, musk ox, an extinct bison, an extinct peccary, and, further south, llama, camel and horse. As a geological group these have been classed under the name of "Megalonyx beds", when found in Kansas and described by Udden, and by Cope as "Equus beds", in which he reported human remains.

The ice epoch waned, the climate became more genial, and all the fauna moved gradually northward. The "Aftonian inter-glacial" epoch supervened. This uncovered for habitation a large extent of country lying to the north of the pre-Kansan moraine. Where this moraine runs has not been worked out. It is probable that it will be traced only in a general way. Its contents may have largely decayed and gone into the composition of clays and soils, and its topography may have been smoothed down by age; or it may have lain so far north that it was buried by the later Kansas ice sheet. On the other hand, there may never have been a distinct pre-Kansan moraine, as that term is ordinarily understood, but the ice may have feathered

out imperceptibly beneath the drift which it bore along and only the slow-moving loess-like mud which it must have produced in abundance over so broad and so level and expanse as the state of Kansas, lapped effectually over the ice and the adjoining land, obliterating all indication of the actual ice-margin, but distributing widely a pre-Kansan loess, partly Glacial and partly aqueous, derived from the easily disintegrated Cretaceous strata of the region. If man existed in America during this (Aftonian) inter-Glacial epoch his remains may be found in the drift of the Kansan ice epoch, or in later drift, and, outside of the ice limit of the Kansan, they might occur on the surface, or near the surface, of the ground, where they had lain from Aftonian time to the present. In this paper such specimens are called Paleolithic, while a few which show the greatest alteration are called Early Paleolithic.

The Kansan ice epoch was like the pre-Kansan, but the ice margin left a distinct morainic accumulation. Its ice-sheet encroached upon northeastern Kansas and its margin, as indicated by its terminal moraine, is shown on the accompanying map. Its moraine contains much red quartzyte, and granite that can be referred to southwestern Minnesota. This moraine is that which is usually considered as the border of the continental ice-sheet. It is evident that the Kansan epoch was one that was marked by rapid and vigorous transportation of drift, in that respect differing from the pre-Kansan. The effect upon man and his associated fauna was quite similar to that of the pre-Kansan, but less prolonged and more intense. It need not be supposed that the drift which forms the moraine

of the Kansan ice-sheet was entirely carried from its sources by the Kansan ice, but a large part of it was probably brought part way by the pre-Kansan ice.

The people that came to Kansas on the withdrawal of the Kansan ice-sheet were probably similar in all essential characters, with those that left it as the ice-sheet came upon them. They had the same necessities and supplied them in about the same way, but perhaps with some increase of skill, the period of time separating them being unquestionably several thousand years. The artifacts which at first they chipped from the chert were rude and large, seldom showing any more design than to *make an edge* with which to cut their meat or to break their small sticks. These were the people of the Buchanan inter-Glacial epoch, so named by the geological survey of Iowa. This people remained in Kansas during not only the Buchanan inter-Glacial epoch, but also, as now supposed, through the later epochs, both Glacial and inter-Glacial, not having been driven away by a return of excessive cold. This long residence may have been interrupted, and probably was, by hostile tribes, and actually there may have been several tribes that succeeded each other in north-eastern Kansas from this cause. While the Illinoian Glacial epoch, affecting the country further north and east, came and went, and was followed by a minor inter-Glacial epoch (Sangamon), the state of Kansas was not so affected that any radical change took place in the nature of the mammalian fauna. These climatic fluctuations may have provoked certain warlike inroads and forced migrations, but it is probable that the new comers were about on a par with their pre-

decessors so far as regards their methods of life and their status in aboriginal culture. The Iowan Glacial epoch was more momentous and projected a flood of muddy water down the Mississippi and (especially) the Missouri valleys, so voluminous that where it reached the latitude of Kansas the banks were full, and sometimes more than full, so that much of the adjacent land was covered. These floods were burdened with a fine silt which was deposited on the land along these rivers and in their valleys, especially along the Missouri valley, and in the Mississippi below the mouth of the Missouri. It everywhere shows traces of horizontal water stratification, and has received the geological designation *loess*. Drainage from the land adjacent carried many land shells into the muddy slime and these are seen interstratified in irregular accumulations in the loess, extending horizontally and indicating the points where tributaries joined the main river. This reduction in the habitable area of the country was unfortunate for the larger animals, and for man. It can cause no surprise that, along with the bones of the mammoth and his associates of the time, have been found, in this loessian mantle of the main valleys, the remains of man, not only in the form of stone artifacts but of his bony skeleton.

The people that lived in Kansas through this Iowan flood were very likely the descendants of those who came there on the withdrawal of the Kansan ice-sheet, and they seem to have improved in their skill of stone chipping. In this paper this improved state of culture is designated Early Neolithic. Not only are the artifacts more skillfully chipped and the finished imple-

ment a product of a higher and more artistic conception, but they show a commensurate state of less weathering, indicating, in their culture, an approach toward Neolithic art, as well as Neolithic, i. e., post-Wisconsin, time. Indeed it has been found convenient, in this preliminary investigation, to class as Neolithic only those chipped implements which show an absolute freshness of fractured surface. There have been found, as yet, no reliable other characters by which to separate the Neolithic from the Early Neolithic. Theoretically the writer would prefer to make all post-Wisconsin artifacts Neolithic. But it was found impossible on that basis to separate some of the Early Neolithic from the Neolithic. In other words, so far as can be determined, there is a sensible gradation from Early Neolithic to Neolithic, both in type of culture and in the weathering shown by the specimens. It was during Early Neolithic time that the arrow-point was introduced, and the mono-clinal scraper and the thin slender knife and the drill. Hence it is that we infer that the American buffalo then became important as a source of food and of shelter from cold and storms. Then followed the Wisconsin Glacial epoch which was more like the Kansan, a period of refrigeration for the northern United States and Canada, of tumultous transportation of drift and of migration from north to south. There seem to have been striking resemblances between the pre-Kansan and the Iowan, and also between the Kansan and the Wisconsin. The two former were epochs of (apparently) long duration and slow, easy transportation, and the latter of less duration but rapid and powerful

transporting power.* The waters that resulted from the Wisconsin ice-sheet re-excavated the loess mantle along the great valleys and brought the natural surface more nearly to the physical conditions of the present.

EXPLANATION OF PLATES.

Plate I.

Paleoliths from Europe, actual size. Page 13.

a Paleolith from the Loire Bassin, Feuardent, France, No. 35122, of the Smithsonian Institution, Washington, and No. 2229 of the Brower Register of the Minnesota Historical Society; showing the coarse chipping and the most glossy surface.

b Paleolith from the drift gravel at Thetford, England, No. 11083 of the Smithsonian register and No. 2228 of the Brower register of the Minnesota Historical Society; showing the coarse chipping and the oldest natural surface, which came in contact with the matrix chalk when the nodule was in the rock.

Plate II.

Paleoliths from Europe, actual size, page 17.

Showing the same European specimens as in Plate I, but the reverse sides. *a* shows the manner of distribution of specks of limonite or limonitic manganese oxide, indicating that this surface of the specimen was

*The writer is aware that the great granite boulders which lie in the area of the Iowan loess in southern Minnesota and northern Iowa have been supposed to date from Iowan Glacial time, and if that is true they form a remarkable exception; but it seems quite easy theoretically to refer them to the time of the energetic Kansas transportation and to explain the bold prominence with which they stand above the surface by superficial removal of the Iowan loess by which they may have been surrounded, or perhaps covered.

turned downward. This surface is less glossy than that represented in Plate I, and also shows, at the bottom, a portion of the old matrix contact on the chalk. *b*, of the Thetford specimen, in point of discoloration and glossiness, does not differ perceptibly from *b* of Plate I.

Plate III.

Paleolith from Kansas, actual size, Page 26.

No. 5212 of the Brower register of the Minnesota Historical Society. Found at the Dreball site, 4 miles west from Alma, in the Mill Creek valley, Kansas. The interior of the specimen is blue-gray. The weather patina is a thin scale of alteration having a gray color without a blue tint, but in some parts being of a dirty buff, still without any marked tinge of yellow. The chipping is very coarse. Along the edge at the lower right hand is a dulled portion showing use by the Paleolithic people. The opposite side, where not chipped, consists of the matrix-contact on the limestone and is of a dirty buff color. Where it is chipped it is less weathered than the side photographed.

Plate IV.

Paleolith from Kansas, actual size, Page 26.

No. 5213 of the Brower register of the Minnesota Historical Society. Found at the same place as the specimen illustrated by plate III. These were both associated with a large number of Paleoliths. As to color and patina this is quite similar to the last, and likewise shows battering by use on the edges. The darker portion at the lower right hand is caused by a

variation in the chert to a very siliceous, coarse, gray rock, resembling limestone, which however has lost all calcareous ingredient which it may originally have contained. It is (here) separated from the chert by a thin layer of dirty white chert.

Plate V.

Kansas Paleoliths, actual size. Page 29.

Nos. 5215 and 5225, of the Brower register of the Minnesota Historical Society. Found, along with an indefinite number of others of a similar character, at the Dreball site, at four miles west from Alma, in the Mill Creek valley, Kansas. These specimens, having squarish outline, are battered by use along the longer edges. The sides photographed show the strongest patinate characters. The chipping is very coarse. The surface is glossy, and considerably lighter colored than the color of the interior.

Plate VI.

Kansas Early Paleoliths, Paleoliths and Paleoliths re-chipped, actual size. Page 28.

No. 5216 to 5224 of the Brower register of the Minnesota Historical Society. Found at the Dreball site, 4 miles from Alma and elsewhere in Mill Creek valley.

No. 5216. The side photographed shows only Early Paleolithic weathering, except that at the edge, along the lower right hand, a part of the matrix contact surface is preserved. The weather scale is yellowish brown. On the reverse side a portion of the surface is Paleolithic and has a dull glossy weather patina, which contrasts with the Early Paleolithic brown weather scale.

No. 5217. On the plate that portion which is enclosed by the dotted line is the freshest of the conchoidal surfaces, but has a dull gloss and may be Paleolithic, especially so since much of the rest of the surface has a dark brown patina indicating Early Paleolithic time. On the reverse side is a larger area of the same.

No. 5218. In this specimen the dotted line surrounds the oldest surface, which is brown, or yellowish brown, and belongs to the age which is considered Early Paleolithic. The edge of the patina is thin, but still has a visible thickness. The rest of this specimen is Paleolithic, with conchoidal surfaces and dull glossy patina, the color being dirty buff, mottled with gray.

No. 5219, whose form suggests a tomahawk, has a weathered glossy patina, equivalent to that characteristic of the Paleoliths. The dotted lines enclose surfaces which are conchoidal and older than the rest, but not covered with a thick Early Paleolithic brown patina, which do not fall plainly into any category adopted in this paper. Other tomahawks in the collection are certainly Early Neolithic.

No. 5220 is Paleolithic throughout, except along the right edge which has a harsh and siliceous coating which was formed round the nodule from which the implement was chipped out. This is one of many in the collection.

No. 5221 is of doubtful age. It is glossy all over, and its color is brown, even inside. It is a piece of a large flake.

Nos. 5222, 5223 and 5224 were made of altered chert. They have plainly, in part, a Paleolithic patina, and on

the back side of No. 5223 is a remnant of an Early Paleolithic surface. Their edges have been broken by use. They may be Early Neolithic.

Plate VII.

Paleoliths from Kansas, actual size. Page 29.

Nos. 5198 (2 specimens) and 5220 (2 specimens). Found in the Deep Creek valley, northwest from Alma on the O'Neal site, along with numerous others.

No. 5198. The weathered surface is gray and light gray, and covers an interior which is blue-gray and gray. The edges have been battered by use.

No. 5220, leaves or turtles like the last, one being broken across and showing only about one-half. These have a Paleolithic, whitish patina and a gloss.

Plate VIII.

Paleoliths from Kansas, actual size, *showing two Paleolithic dates*. Page 30.

These specimens are from the Mill Creek valley, and No. 5226 are from one and three-quarters mile northwest from Alta Vista.

No. 5226 (three specimens) are described in the text, p. 30. The weathered surfaces of different dates are outlined on the plate. The oldest surfaces shown on the two large figures at the top of the plate have a weather scale of different colors. That in the left hand upper corner shows a brown scale, not glossy, marked "pre-paleolithic". That in the right-hand upper corner has a dirty cream-colored scale. But that in the lower right hand corner has a more nearly white Paleolithic weather scale.

Specimen No. 5114 is described fully in the text. It shows plainly three weather stages, viz: Early Paleolithic (1), Paleolithic (2), and Neolithic (3). The Paleolithic weather scale is white or dirty white, as in No. 5226 next adjoining to the right.

Plate IX.

Paleoliths from Kansas, actual size. Page 33. *Showing Early Paleolithic, Neolithic and Early Neolithic Chipping.*

These are all from the Mill Creek valley, and No. 5227 from one and three-quarters miles northwest from Alta Vista.

No. 5115. In addition to the description given in the text (p. 33) it may be stated further that the Early Paleolithic surface (1) is divisible into two parts, a and b, a having a white, thin, unglossy weather-crust seen on both sides of the specimen, lying upon a thick brown crust, b; that No. 2 intersects both a and b and that it shows entirely a brown and glossy patina whether it covers b or the original olive-gray chert. The chipping (3) about the edge at the right is much later, but doubtfully Neolithic, although it has a gloss which elsewhere is unquestionably Early Neolithic. The chert of this specimen is dense in texture and of olive gray color.

No. 5013. Shows Paleolithic and Neolithic chipping, but the Paleolithic surface is not glossy. It is outlined in the central part of the figure, and it may be later than pre-Kansan. It contrasts strongly with the Neolithic chipping about the edges of the specimen.

No. 5030. A bi-terminal scraper, showing Paleolithic and Neolithic (or Early Neolithic) chipping.

No. 5227. Shows two dates of chipping. The larger specimen bearing this number has a plain Paleolithic area in the center, as outlined, and an equally plain fresher fracture all about the edge, apparently of Neolithic date, produced by use of the piece as a hammer,—perhaps for chipping other pieces.

No. 5008 shows a rough Paleolithic crust of decay surrounded by Neolithic chipping, producing a notched "point".

Plate X.

Kansas Paleoliths, actual size. *Showing Early Paleolithic, Paleolithic and Neolithic Dates.* Page 34.

From the Mill Creek valley.

No. 5226. A characteristic squarish specimen, the most of the surface having a nearly white Early Paleolithic weather scale, the chipping having been done by Paleolithic man.

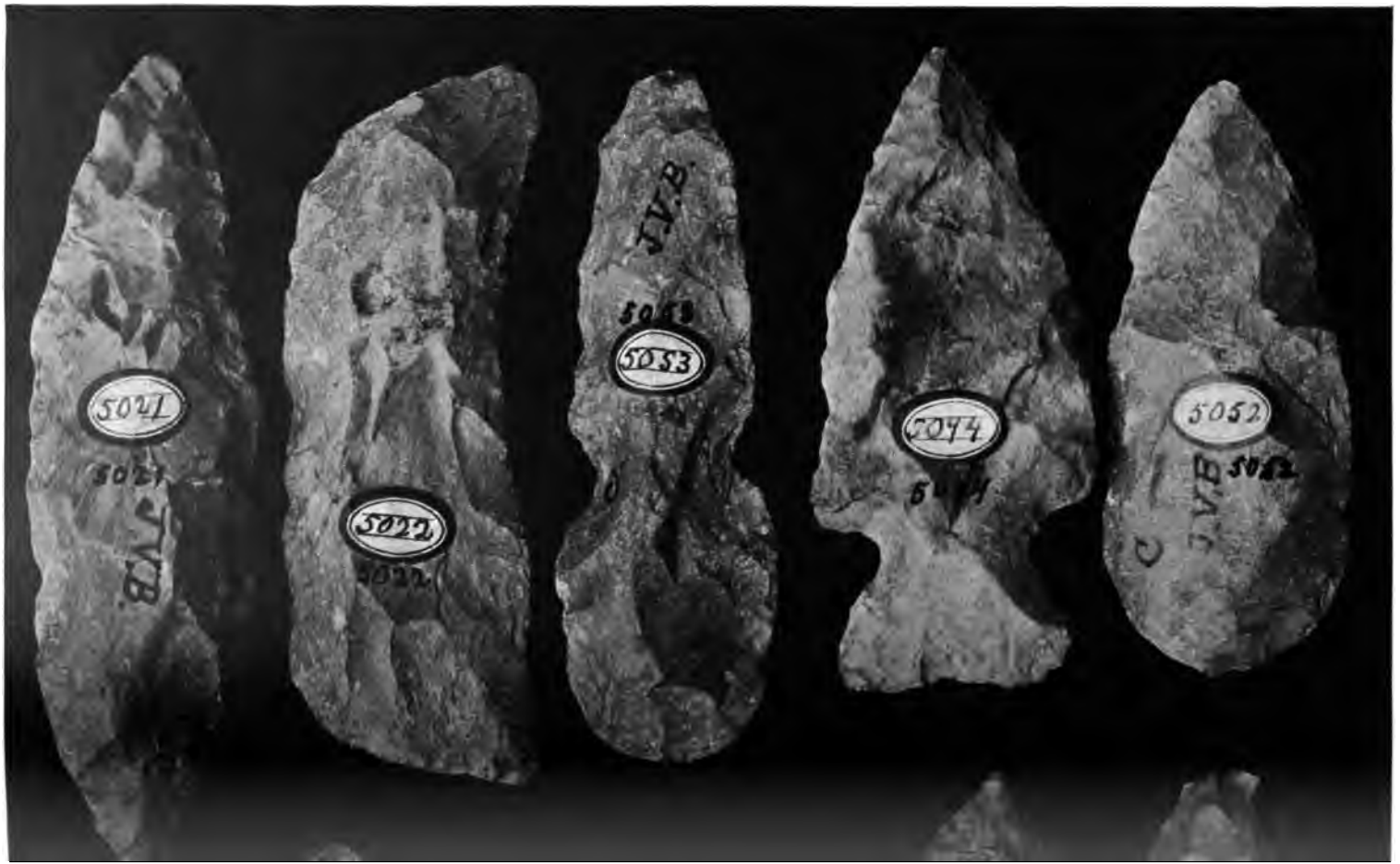
No. 5227. A similar specimen, roundish instead of squarish, chipped to an edge along the top by Neolithic man. The Early Paleolithic scale is not so thick as on the other. Both these specimens show, by their curving chip-surfaces, that Early Paleolithic man was a chert-knapper.

Detailed description of Plate XI, showing specimens not Paleolithic, taken from Mill Creek valley. Beginning at the upper left-hand corner. The figures show the actual size of the specimens.

No. 5021. Light gray chert, dense and siliceous, probably a variant of the blue chert of the locality, but fresh and wholly unweathered; battered along the

EARLY PALEOLITHIC, PALEOLITI

IC AND NEOLITHIC. PAGES 34, 64.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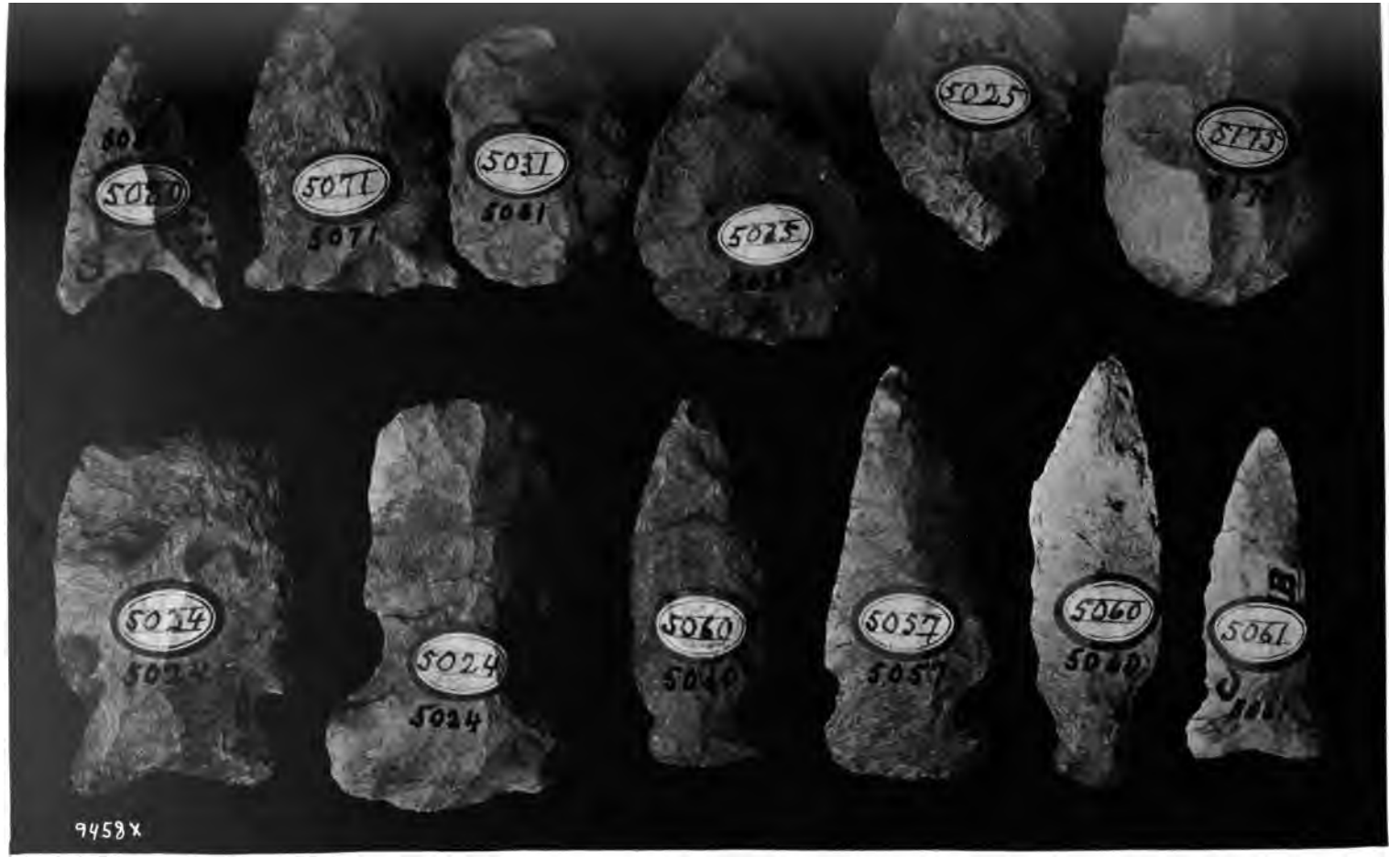


SHOWING SPECIMENS NOT PALEOLITHIC. PAGE 64.

edges, apparently (or possibly) to bring the piece into form in the finishing touches, rather than by use as an implement. The blows that caused the battering were directed about perpendicularly upon the edge, as indicated by the fact that usually the little slivers flew in both directions. It is noticeable that sometimes the most battered points are at places where the edge was clumsy, or too thick, and that this extra thickness remains even after the battering, indicating that at those points the edge was at first also unduly prominent. This delicate implement is perfect in outline, although it was coarsely chipped out. This Harahey knife (so named by Mr. Brower) is not characteristically beveled, and is probably Neolithic No. 1.

No. 5053. Small tomahawk, blue-gray chert, section rhomboidal. All the chipped surfaces are quite fresh excepting only a small space on the reverse side near the larger end. This remnant, as well as those mentioned on the last, cannot be called Paleolithic. The edges along the sides and on the larger end are battered as described, and it is important to notice that this battering descends into the notches and also appears on the central longitudinal ridge between the notches, on the reverse side. It does not appear on the central ridge on the side shown. These facts seem to show that the battering of the edges was purposely done in order to shape the outline of the implement, and is not due to use.

No. 5022. Quivira knife, (from Mr. Brower), blue-gray chert, canoe-shaped. This is freshly chipped all over excepting two remnants of an older chipped surface visible on the reverse side.

No. 5094. Spear-point, or knife, freshly made from the blue-gray chert. The edges are battered and the surface has a sub-gloss which indicates some age. (p. 35).

No. 5052. Knife, freshly wrought from the blue-gray chert of the region; edges are somewhat battered.

No. 5080. Point, tangless, but conspicuously barbed; this specimen is light gray, apparently an altered state of the chert of the region, in that respect differing from No. 5021, above, which is a different chert. Its edges are battered. It is freshly made, but a remnant of an older surface is apparent on the barb at the right-hand side, while all over the specimen there are some facets that exhibit a subdued sub-gloss like that seen on No. 5094.

No. 5071. Point, blue-gray chert, considerably older than any of the foregoing, but not Paleolithic; edges scantily battered as above. The whole outer surface has a shininess due to age, but not equal to the Paleolithic nor to the Early Neolithic, but approaching the latter. It shows no fresh chipping.

No. 5031. Scraper or knife, blue-gray chert. In the main this is fresh, but has remnants on either side of older surfaces. Neither end is characteristically mono-beveled. It might be called a small "turtle." It is somewhat battered on the long edges.

No. 5035. Scraper, blue-gray chert, but not of characteristic form nor of mono-beveled end. It is pointed-ovate. While this is probably of modern make, it is not fresh like 5021 or 5022, or 5053.

No. 5025. Leaf, altered chert of the region, having lost its blue-gray color, pointed at both ends. It is

freshly made, but exhibits two stages of weathering on the chipped surfaces, edges slightly battered. The remnant of the older surface mentioned in the text can hardly be detected except with a magnifier, and with favorable reflection of the light.

No. 5175. Scraper, blue-gray chert, mono-beveled and thick at the larger end. Edges somewhat battered. As for age, this is one of the Early Neolithic specimens, not Paleolithic, though having a somewhat shining surface due to age; both sides alike as to age. Complete and typical.

No. 5024. Point, or bunt, notched, of blue-gray chert. This was a tanged point of early Neolithic age as to weathering, and shows fresher fine battering along the edge.

No. 5024. Point or bunt, or knife, blue-gray chert, mottled with altered chert. This shows some Paleolithic (?) and Early Neolithic surfaces, but the most of the chipping is fresh; edges battered especially in the notches.

No. 5060. Point, narrow, blue-gray chert; evidently a Neolithic implement, but not freshly chipped; edges dulled from the notches to the point. Notches slight.

No. 5057. An Early Neolithic flake of blue-gray chert, chipped about the edges, the notches and the tang, to the form of a point; less fresh than those along the top of the plate.

No. 5060. Point, or knife, like 5060 above, but comprising also altered chert. (Perhaps Early Neolithic; it is not fresh; it is not Paleolithic).

No. 5061. Point, blue-gray chert. A Neolithic implement, but not freshly chipped.

For explanation of plate XII, see p. 125, and of plate XIII see p. 127 and of plate XIV see p. 131.

V. CRITICAL WORKING OBSERVATIONS ON SOME KANSAS SPECIMENS.

After the foregoing summary of preliminary results respecting the Kansas artifacts had been put into shape for publication, on further examination of the same collection some interesting new features and some additional ideas were developed. It is thought best not to intercalate these in their places in the original paper, but to present them somewhat chronologically, as they were observed. The original paper as here presented was read by several, including Prof. F. W. Putnam, of Cambridge, Mass., Judge J. T. Keagy, of Alma, and Prof. J. E. Todd, of Lawrence, Kansas. Some corrections and suggestions made by them have been used to make the article correct. The notes which follow were not thus submitted. However, after these notes were written, through the mediation of Prof. Putnam the writer was enabled to examine a copy of a remarkable article by Dr. W. Allen Sturge, of Mildenhall, Suffolk, England, who has recently reached conclusions as to the extension of Neolithic culture into the pre-Glacial past of aboriginal man quite similar to those expressed in this article, and the conclusions of Dr. Sturge are based on a critical study of the kinds and stages of patination of implements found in Suf-

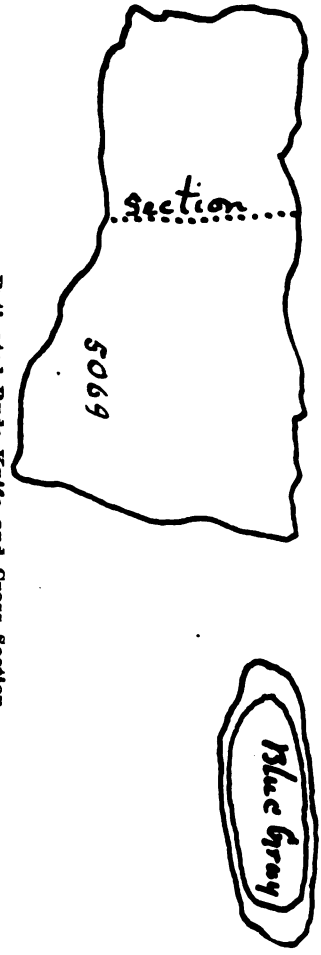
folk, and other parts of East Anglia.* It is another instance of the near contemporaneity of results reached by different workers along the same line of research, carried on independently on opposite sides of the Atlantic. The writer is not familiar with the publications of French or other continental archeologists, and it is quite likely that similar distinctions have been observed by them. Dr. Sturge's conclusions are based, also, on the Glacial striations which his specimens exhibit, proving the later date of the ice-age or ages.

February 15, 1912. I began to lay out a collection of these artifacts, i. e., of the Paleoliths, which showed by the battering of the edges that they had been used for cutting; but I soon found that nearly every one had been so used. Every one (I hardly know of an exception) shows a mashing and fine fracturing as if done by pounding, or other contact, on a piece of wood or of other stone. This battering is found along some long edge, or near some angle or place of vantage, which could be made to serve as an ax or chopper in the hand of the owner. It seems as if the full purpose of the knapper was to get a simple edge, whether on a large piece or on a small one, and that he knew nothing, or next to nothing, of the finer art required to make an arrow-point or a scraper. The limit of their skill was in the formation of a tomahawk or a turtle back.

Note. Some of the Early Neolithic class show a calcareous scale, or "Glacial patina", as I have elsewhere called it. (*Records of the Past*, vol. 8, p. 251.)

*Proceedings of the Prehistoric Society of East Anglia, Vol. 1, Part 1, 1910.

Paleolithic Culture in Neolithic Time.



Patinated Rude Knife and Cross Section.

February 24, 1912. I find by continued examinations (of other Kansas specimens) that the place of origination of the scraper, in the Glacial scale, is still doubtful, as there are some patinated specimens which are r u d e l y mono-beveled which appear to express the scraper idea. I have laid out a few. I also find a specimen (No. 5069) which is a piece of what may have been a "Quivira" knife, like this figure, which not only is patinated by long weathering, but on being broken, as shown by the dotted line, has a distinct, light-colored patina which can be seen surrounding the unweathered interior, and which has a nearly uniform thickness, but is thicker on one surface. It appears, hence, that the feeble commencement of Neolithic culture was in Paleolithic time. The Quivira knife in its perfection appeared in Early Neolithic time. Not only are Paleolithic rude implements found that date from Paleolithic

time, but lately chipped implements of the same, or similar, shapes are found in the Kansas valley, the freshness of which will not allow of their being older than Neolithic time. Some leaves, or turtles, having both sides convex, are of this character, also some rude knives, the latter showing not infrequently a recent chipping superposed on a distinctly Paleolithic chipping (5304), as if the later artizan had tried to continue, or to improve, the implement for the use for which it was at first designed. This fact seems to indicate that the idea of the first artizan was satisfied in the creation of the rude "turtle", and that the later artizan recognized the idea and attempted simply to perpetuate it. This sequence is specially evident in some implements that are not so characteristically "blanks", but are leaves (5309) somewhate ovate, whose edges are battered by use. It appears hence Paleolithic culture persisted in some degree in Neolithic time.

There is no doubt in my mind that the Paleolithic implements, especially the oblong or ovate-oblong so-called "turtles" or "blanks", of W. H. Holmes, as found here were completed implements as they now exist, since the long edges are frequently battered by use; and the same is true of those larger rude implements which taper roughly to a blunt point or so as to afford a handle for a person who wished to use them as hand axes or gouges This statement is true, also, of numerous other pieces of irregular and purposeless shapes, but which happened to develope a long suitable edge in the process of rough chipping. Such pieces are battered along the edges thus pro-

duced. I have about reached the conclusion to put all artifacts whose culture precludes Paleolithic in the Early Neolithic, which have a marked shininess pertaining to the youngest chipping, and retain in the Neolithic only those whose latest chipping is evidently fresh. Of course there are numerous specimens that show two stages of chipping, and in such cases the latest chipping is often designed to carry to more exact completion the design which was apparent in the earlier chipping. But in other cases the design is apparent only in the later chipping. This is very often the case with the mono-beveled scrapers. The large flakes which certainly were produced in large numbers by Paleolithic man, (as well as by the Early Neolithic) were employed by the later men to make the conventional scraper. The flat side (i. e. that which cleaved from the core) is longer weathered than the surfaces formed by the beveling, sometimes being Paleolithic, but more frequently Early Neolithic, and when the latter they can hardly be distinguished sometimes from Neolithic beveling. No beveling of this kind has been found which can be called Paleolithic.

Iron Mould.

March 9, 1912. I notice that some Paleolithic pieces which have a light gray color throughout acquire a blue-gray color by weathering. This change occurs sometimes in oolitic parts, and is rare. There is also a curious sprinkling of iron rust. It is found but occasionally, and prevails along the crests of anticlinal ridges formed by the intersection of two fracture planes. but it also occurs on smooth surfaces. It ap-

parently is not due to the oxidation of contained pyrite, but appears to be entirely a deposition from the outside. (see however p. 128). Occasionally it forms an interrupted small streak running in an unexpected and unexplainable direction across a flat or slightly curving surface, as if some iron tool had left a portion of itself on the spot on being dragged across it. This idea is strengthened by the finding of a spot wihch gives a metallic luster, somewhat striated, in which a few centers of oxidation were to be seen, exactly like those which occur generally. (These so-called metallic surfaces I find, later, are natural cleavages of the limonite.)

March 18, 1912. How to account for the curious distribution of brown hematite (already mentioned) is a puzzle. Can it be as follows? It is essentially a very late, probably post-Glacial, effect, and as iron oxide is the chief coloring agent in turning the chert brown, can any cause be named that would make it accumulate in this manner? The most evident feature in this oxide of iron, in its manner of distribution, is its accumulation in *streaks*, such as may have been formed by a hard tool (iron apparently, but perhaps another chert) dragged forcibly over the surface of the chert where the oxide has formed by chemical secretion. In case the surface of the chert were slightly crushed or powdered along such an accidental streak, would the crushed condition of the surface cause a more rapid deposition or a detention of iron along such a streak (or scratch)? I notice also that this curious accumulation is along a narrow belt where the chert is not crushed, but is covered by a thin coating of some-

thing like evaporated albumen, having a glistening surface when not removed by friction nor covered by the oxide.

March 19, 1912. When this brown hematite occurs along a ridge formed by the intersections of two flake surfaces, which is very common, it seems impossible to ascribe it to a scratch by some hard foreign tool or other substance. In such cases I see it is not only scattered along the whole crest of the ridge, coloring the surface in a narrow strip, but forms, at somewhat regular intervals, little bunches, or concretionary spheres which lie exactly on the crest of the ridge, these being evidently simply local enlargements due to greater deposition from ferriferous solution. These little concretions are so numerous sometimes as to form almost a continuous line, but being hollow they can easily be broken and removed, after which there remains only a portion of their crusts. It is not found exclusively on ridges, but occasionally on flat or curving surfaces. The appearance suggests that from the lower (?) side of an artifact ferriferous water was slowly trickling and evaporating, and that the iron in solution had slowly gathered on evaporation of the water, after the manner of stalactites. The ridge, in any case, governed the deposition, as to place, since, in one case, a distribution is seen like this figure. At *a* is a line of limonite running along a crest, at *b* the crest is interrupted by some means, and a slight depression takes its place, but the irony deposit divides,

Streak of Iron Mould.

following the two new crests formed, surrounds the slight depression, and uniting again at *c*, continues further as one streak. There is, however, in no case observed, any calcareous deposition cotemporary.

On a Paleolith from Loire Bassin (No. 2229) similar irony spots, in form of isolated small scales, but of darker color, are sprinkled over one surface, apparently the surface which was downward during a long period, though they are absent from the other surface. They are not on the ridges but in the depressions or on planes that slightly curve downward. They are wholly wanting on the ridges,—or occur there only accidentally and rarely. On the specimen from Thetford drift (2228) of England, only two spots are found where such accumulation of iron is seen, and these are on ridges, in manner comparable with the accumulation on the Kansas artifacts.

Variation of the Chert.

This chert passes into a porous, siliceous chert-looking rock containing many minute fossils, which weathers to a rusty brown. This occasionally is seen adherent on some of the implements, and rarely constitutes the sole material of some of the implements. This does not effervesce, and should not be mistaken for the limestone of the region. The chert also varies in the compactness of grain, becoming occasionally very fine-grained and hard, approaching flint and agate, and along with this compact texture and denseness of grain it is somewhat variegated in color. These can be seen sometimes in the same specimen, one of the colors being pinkish. I do not know that

Mr. Brower's "pink chert", supposed by him to have been imported from Missouri, can all be referred to local variation in the Kansas chert, but it seems to me to be possible, and may have been common in Missouri.

Criteria of the Different Ages of Weathering.

March 7, 1912. There are plainly three weathering stages which are evident and easily distinguishable, viz., Early Paleolithic, Paleolithic and Neolithic. The Early Neolithic is indefinite, it shades into the Neolithic in various steps of approach and rarely it is also difficult to decide on the basis of weathering alone between Paleolithic and Early Neolithic.

The Early Paleolithic (and the Pre-paleolithic) chipped surface is characterized by:

(1) The deepest alteration of color. This colored scale may be

(a) a dirty, cream-colored white, formed on a somewhat vesicular gray chert, illustrated by the two specimens seen in plate X. Its thickness is very apparent, varying from that of card paper to three or four times that thickness; and sometimes, apparently on the protected (lower) surface of a specimen, this scale is distinctly stained with iron rust, even becoming pinkish or red. This scale is smooth but not glossy.

(b) a brownish-yellow, formed on a dark gray, or blue-gray, and dense chert. Its thickness is about the same as the last, but its surface is glossy and has a darker brown color, almost raw umber brown. The contrast between this weather-scale and the interior

is very marked, especially when any part of glossy exterior is preserved.

(2) By a change in the texture of the chert, by which the chert, when fractured, exhibits a finely granular internal structure, having a harsh feel. This is true whatever the color of the scale. This granular internal structure can hardly be seen except with a magnifying glass. It seems to have been formed by minutely fine sedimentary deposition, since sometimes a scattering of grains of different color can be distinguished.

Pre-Paleolithic surfaces, not chipped, are rotted and spongy, and not glossy, whitish or somewhat rusty with iron, and even reddish by concentration of iron oxide. The rotted scale may be of any thickness up to half an inch.

The Paleolithic weathered chipped surface is characterized by

(1) An alteration of color like the foregoing, but less extended, the thickness of the scale being generally not more than one-half or even one-eighth of that of the foregoing, and sometimes almost imperceptible as a weather-scale; yet manifested by a superficial change of color.

(a) If the interior of the chert is blue-gray the surface color is likely to be the same, but lighter colored, especially on one side of the specimen, i. e., that which was downward during a long exposure, or when it was otherwise sheltered from atmospheric friction. The surface of a blue-gray artifact which was not so sheltered shows an accumulation of what appears to be dirt, but it is inti-

mately united with the surface of the chert, and will not wash off, nor brush off, giving the specimen a dirty aspect, although the surface may show a glossiness at the same time.

But sometimes a dense specimen having a *light blue-gray* interior, or a light gray interior, becomes more deeply blue, or blue-gray, on the immediate surface, but the weathered scale, below the blue surface, is brown and vitrified.

(b) If the interior of the chert is dense and light-colored, i. e., a light gray, the weather surface may be about the same, but tinted with yellow (or with blue-gray, as mentioned last above). If it be somewhat vesicular and light-colored the alteration is deeper, but of the same yellowish light color.

(2) Uniformly, some portion of a Paleolithic artifact, along with coarse and rude chipping, will show more or less glossiness. This glossiness sometimes is hardly perceptible on an artifact of the light-colored and versicular chert, and on more dense chert if the specimen has been sheltered from atmospheric friction. A glossy surface, however, can be acquired in a shorter period when the dense artifact is favorably exposed to blowing dust and sand on the prairies. If the specimen be not accompanied by rude and coarse chipping, nor by a thin weather-scale, the artifact probably belongs in a later stage of culture.

Paleolithic and Early Paleolithic artifacts sometimes show glacial patina.

In general, the denser the grain the thinner the weather scale and the better the gloss.

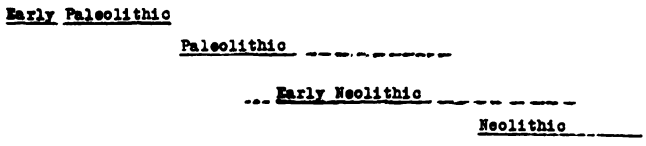
A weather-scale may exist without any glossiness, and a glossiness may exist with no perceptible weather-scale, the latter in the Early Neolithic specimens.

An Early Neolithic weathered chipped artifact is marked by no perceptible (or very slight) depth of weather-scale, but shows a change of surface color or a glossy surface, or both, in whole or in part, usually combined with finer work; glacial patina occurs sometimes on these.

A Neolithic implement shows, normally, neither a weather-scale nor a glossy surface, but it is often difficult to determine between Early Neolithic and Neolithic, owing to successive chipping of the same piece, and to similarity of culture and probably also to differences of exposure. In this paper the term "Neolithic" is applied only to those artifacts which are so freshly chipped as to be referable to the present Indian dynasty.

Gradation of Culture Stages.

There is a gradation of culture stages into each other so that they overlap in the Early Neolithic, thus:



The culture of the Paleolithic, so far as shown by the chipping and the nature of the implements, extended into the Early Neolithic, and the Early Neolithic into the Neolithic, but in diminishing force. Appar-

ently some Paleolithic forms were fabricated in Early Neolithic time (perhaps also in Neolithic, but these have not yet been certainly identified), and Early Neolithic culture forms were fabricated in Neolithic time, showing the Neolithic freshness; but the converse is not true, i. e., in proceeding up the stream of progressive culture the new and higher forms seem to cease suddenly and entirely. Few specimens (one only, v. p. 70) having an Early Neolithic culture have been found in Paleolithic time, i. e., with Paleolithic weather-scale, but sometimes with what cannot be distinguished from a Paleolithic gloss. In the same way, Paleolithic chipping, so far as seen as yet, is separable from Early Paleolithic. (This is to be further tested).

(April 6, In general these distinctions appear to be sustained, but need further verification.)

(June 8, These statements are O. K.)

March 13th. It is apparent that many so-called "points" were knives, and were fastened on the ends of handles. This is shown by their frequent battered edges, and by the fact that many of them are too large for use as arrow-points.

That the grain of the chert, whether fine and dense, or coarser and loose, has much to do with the existence of a gloss on the weathered surface, is quite evident, not only by the comparison of separate individual specimens, but especially by the appearance of a knife (point) No. 5433. This specimen is composed of two sorts of chert, both kinds having a tendency to pink. These kinds are irregularly distributed with respect to each other, but they are persistently distinct, though in immediate contact. The coarser

kind is pink, and never polished, coarser grained and sparsely sprinkled with fine fossil fragments which are white. The dense kind is mostly brown, with a shade of red, and is uniformly glossy, with no visible fossil remains. The glossiness on the brown surface causes its classification as Early Neolithic, although the appearance of the other chert would indicate a Neolithic age.

Critical Observations.

March 14. A fine Early Neolithic point (No. 5463) shows partly pink and partly brown, and the colors grade into each other, indicating that they are different stages of ferruginization, and, because elsewhere both the pink and the brown separately grade into the blue-gray chert, they can be both assigned to a change in the originally blue-gray, but a change carried out while in the rock containing the chert.

Significance of a Gloss.

March 15, 1912. I notice that in the case of a lot of broad points (5475 to 5484), all from the "Kilian site" and quite similar, almost identical in size and shape, and apparently referable to the same date as to style, culture and weathering, while the most of them have to be classed as Early Neolithic on account of the existence of more or less glossiness, yet a few (6 or 8 in 31) show no gloss and, under the rule under which I am working, these are classed as Neolithic. It is apparent from this, and from other facts observed, that Neolithic specimens might acquire a gloss, and that the existence of a gloss is not a sure guide to the age

of the specimen. This applies to some specimens showing a glossiness which may actually be Neolithic, although put in the Early Neolithic group. Still it may be that these presumed Neolithic specimens have lost a gloss (if they ever had it) or may have been so protected from friction that they could not acquire it, though as old as those that have it. At least it is evidence that the criterion (gloss or no gloss) is one that may have exceptions, and must be employed with caution.

See further, under "Different rates of patination," p. 102.

I have already noted that even Paleolithic artifacts sometimes (though rarely) show but little glossiness.

Specimen No. 5502 is a rude, irregular blade, seven inches long and nearly four inches wide. The central portion, on one side, is of Paleolithic age, with undulating, forced, fracture-surfaces. All around the edge this piece has been chipped in Early Neolithic time, and in part, apparently, in Neolithic, but the later working did not much change the shape nor evident purpose of the implement.

Persistence of Paleolithic Culture.

From this it appears that Early Neolithic man was satisfied, in some instances, to use a very rude implement, and even to chip out one, though he frequently employed a Paleolithic implement as a base. Numerous artifacts showing Paleolithic and Early Neolithic chipping indicate an approximation toward identity of culture, so far as can be determined by the remaining Paleolithic surfaces, but others show, along with

more recent chipping, a wide separation and approach toward Neolithic culture. Were it not for the differences of weathering, a casual examination could not separate them, in some cases, and the whole might be placed in one age, only requiring some such distinction as "*cache*" implements, or "blanks" to receive the "Paleoliths" whatever their age. It appears that the Paleolithic artizan, at least his art, was not wholly replaced by Early Neolithic art.

Relative Number of Early Neolithic Specimens.

I find that by far the greatest number of artifacts, judged by the age of the weathering, fall into Early Neolithic time. There are very few that can be certainly classed as Neolithic (according to the foregoing definitions), and none of these, so far as examined, are "polished" (i. e. ground) implements. They simply show recent chipping. There are not so many whose entire surface is plainly Paleolithic, and fewer still Early Paleolithic, and there are some whose culture and whose glossy surface would allow of their being either Paleolithic or Early Neolithic. But along with a patina of gloss, a true Paleolithic usually exhibits also some weather-scale—but still the gloss may be wanting and only a weather-scale of white or brown then may determine its Paleolithic age. A specimen showing chipping of two or more dates is classed in accordance with the latest chipping.

Weather Scales Are Sometimes White And Sometimes Brown.

March 31, 1912. *Note.* Query: Why are the oldest surfaces sometimes brown and sometimes white,

or nearly white? It is evident that when the surface is white all the color elements, chiefly iron, have been removed from the chert, and only the silica remains, and that when the oldest surface is brown, there has been added to the chert some coloring element, chiefly iron. It follows that in order to answer the question it is necessary to find some cause for this different action of iron. It is probable that the cause is some way connected with the chemical environment. In one case iron is supplied to the chert and hence there must have been more in the environment than in the chert. In the other case either some acid surroundings leached out the iron from the chert, or perhaps the presence of decaying organic matter caused its removal. Decaying organic matter, as in a peat bog, causes the accumulation of iron in and about itself, abstracting it from waters that carry it in solution. It may be, therefore, that acidulated waters and decaying organic matter may both be concerned in the production of this diffeernce of weather scale, the former to abstract the iron, by solution, from the surface of the chert where conditions were favorable, and the latter to cause its accumulation on other surfaces when situated in the presence of decaying organic matter, as in a low tract of land where the prairie (or the forest) vegetation accumulated over the specimen, or in situations where drainage was not free.

April 1, 1912. Again, I have noticed that, on some specimens, weather scales of both colors are present, on the same surface, the brown one next the uncolored chert, and the white one, (which is usually a dirty white) on the exterior. Ordinarily, the first effect of

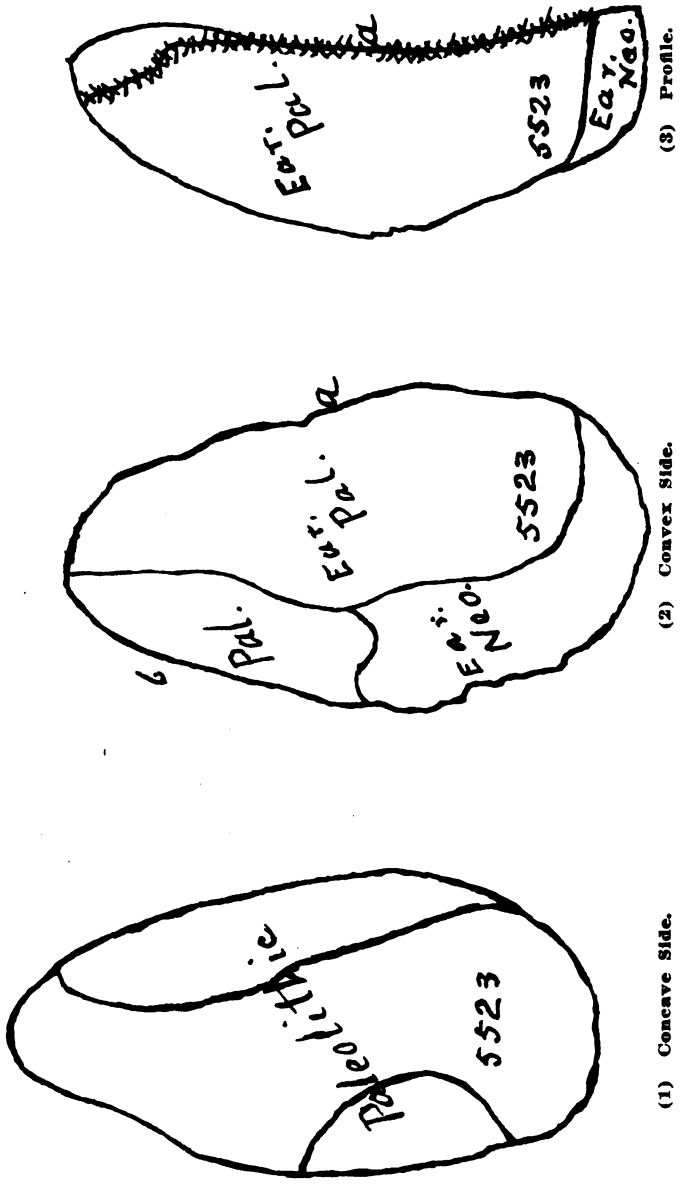
weathering, so far as change of color extends, *i. e.*, after the formation of a gloss, is the deepening of color by the accumulation of a rusty coating, and by the absorption of iron into the meshes of the chert. By some change in the chemical environment the surface of the brown scale seems to have been deprived of its color element and converted superficially to a white color. There are, besides, considerable masses of the chert which are deeply altered in color by the absorption of iron, sometimes becoming buff-white, or yellowish-brown, or merely reddish or pinkish, and some artifacts are made wholly of such colored chert. Of course such coloration must have been produced before the chert of which the specimens are composed, was extracted from the parent rock, and while the conditions of its environment were dependent on the formation carrying the chert. Ordinary superficial weathering, however, due to exposure in Pliestocene and post-Glacial time, affects only a scale of varying thickness, or which indeed is so thin as to be almost invisible.

There is a question as to the significance and durability of a gloss on a weathered surface. Can it have rotted and been followed by a patina of decay?

Unfinished Edges On "Turtles."

April 1, 1912. In some instances it is noticeable that artifacts of the "turtle" form are not completed, but an edge, at one end or the other, is left unchipped, and so dull, or flat, that it was utterly impossible to use it for cutting meat or other objects. Such unfinished edge is thicker, and sometimes would furnish

a partial handle, or such enlargement that in the grasp of the hand the implement could have been more securely and effectively wielded. Whether it were in-



(3) Profile.

(2) Convex Side.

(1) Concave Side.

tended for such a purpose or not, it has also occurred to me that perhaps the edge for which the artifact was made was developed gradually, and that in the exigencies of savage life the artizan found it necessary to interrupt his chipping and to use, or to allow to be used, such edged portion as was ready, calculating to finish the implement at a later date. At such later date he would probably chip another part of the edge, or all of it, and thus have a fresh and keen cutting edge for later service. This may explain not only the existence of wholly unchipped portions of the edge, but also the contrasts which the two edges of an implement sometimes present, one edge (along one side) being considerably more dulled by use than the other.

Early Paleolithic, Paleolithic and Early Neolithic Chipping on the Same Specimen.

April 2, 1912. The specimen figured on p. 86, (No. 5523) is quite interesting and suggestive. It is brown all over, on all sides and edges, except where Early Neolithic chipping has served to give it a mono-clinal bevel at the broader end, where it is gray. It was a Paleolithic knife made of a flake from an Early Paleolithic parent mass, the only remaining part of the Early Paleolithic surface being on the convex side of the specimen, as indicated in Figure (2). The Paleolithic chipping developed two cutting edges *a* and *b*. Of these, *a* was much used in Paleolithic time, as evinced by the dulled edge and by the brown-patinated, fine and worn fracture-surfaces which extend the whole length of the edge *a* as far to the point where a later chipping has removed them and furnished the

implement with a new sharp edge which remains nearly entire and fresh. The edge *b* is battered also somewhat by use, some of which appears as fresh as the mono-bevel at the broad end. The paleolithic surface shown in Figure (2) is reddish-brown and the patina is much thinner than the brown Early Paleolithic surface which it intersects. The thickness of the brown-patinated scale can be seen all along the convex back of the specimen from one end to the other. It is about as thick as card paper. The thickness of the weather-patina on the Paleolithic surface is also visible at the line of intersection of the Paleolithic surfaces in Figure (2). The Early Neolithic surface shown in Figs. (2) and (3) is characterized by finer flaking, by a gray color, and by a glossiness such as appears on all those artifacts which have been classed as Early Neolithic. This glossiness in other specimens is sometimes distinguished with uncertainty from that which is Paleolithic, but in this specimen there is no uncertainty, inasmuch as two other earlier-chipped surfaces are brown with an old patina, which certainly removes them from the age of the Early Neolithic, and which shows that during Paleolithic time the specimen was exposed to the weather under circumstances that were almost identical with those of Early Paleolithic time, but less prolonged. On the Early Neolithic surface there is no brown color, but the gray color of the chert has a faint tinge of buff, which is no doubt due to the action of ferruginated water, since the latest chipping was done, and which, if continued long enough, would finally produce a brown patina scale such as seen on the rest of the specimen.

It might be mentioned further that near the crest formed by the intersection of the Early Paleolithic surface with the later chipping (Figure 2) is to be seen a small amount of the iron rust already mentioned as if deposited in the manner of stalactites in caves.

(June 8, 1912. The foregoing described specimen was lost somewhere in Ohio on my late expedition during May, probably at Newark, Ohio. It had already been shown and interpreted to a number of archeologists and others in Kansas and Missouri.)

Successive Weather Scales.

April 7, 1912. In the matter of weathering, and the colors assumed by the weather scale, it appears plain that the first effect is the formation of a gloss. By long-continued exposure this gloss is lost (or may be lost) and a slow decay begins, this decayed scale being sometimes white and sometimes brown, depending upon the environment, and if brown it may become quite thick, and may then be covered by a white scale. This is illustrated by specimen No. 5115, of plate IX. Below both of these scales, in some cases, can be seen layers alternating with each other two or three times, white and brown, and deepest of all there is a purple scale. These repeated alternations are too deep, especially the purple layer, to warrant the supposition that they denote successive epochs of surface exposure when they were attacked directly by the weather. They indicate, more likely, variations in the intensity of the weathering forces, or in the supply of the coloring elements, before removal from the parent rock, by reason of which a banding was given to the

mass of the chert which recalls the banding of colors seen in banded agate. This, however, is a rare feature of the Kansas chert. It is seen sometimes at Flint ridge, Ohio.

Uniformity of the Kansas Chert.

April 9, 1912. I have found the chert quite uniform in color and texture, within certain limits of variation. It is sometimes denser, and then is likely to have a dull gray color, and also is sometimes banded with brown-gray, and when dense it is sometimes brown throughout. These dense specimens acquire and retain a gloss easily, while the blue-gray, being softer, sometimes seems to acquire a color scale of slight decay rather than a gloss, and in some cases I have suspected that they had a gloss at first but have lost it by reason of different exposure. In general this blue-gray and rather soft chert is not exactly comparable with the Chalk flint of England in this respect, and it cannot be expected to exhibit (as it does not) the bright, firm gloss seen on those specimens.

I have one white quartzyte scraper (5544) the material of which probably came from the local drift. I have seen no chert, as yet, which must be excluded unqualifiedly from the local chert beds, as a source,—except one small triangular point (5599) which is black.

Paleolithic or Early Neolithic?

April 10, 1912. It may be necessary to allow to the Paleolithic fabricator the idea of a rough knife, since I find one (5592) on which there is a distinct white

weather-scale which, though thin, is no thinner than some seen on some Paleoliths. The coarse chipping also would allow the Paleolithic date. (See note of February 24).

The difficulties with allowing specimen No. 5592 in the Paleolithic group are as follows:

1. It is distinctly chipped to a knife shape, having a point and a regular curve on each edge, coming to a rounded end.

2. Its rounded end shows a few finer chip-scars, bringing the shape more to a bevel, though by no means like the mono-bevel of the scraper.

3. It is an entire knife-like implement, and finished, and was used as a knife, as proved by the battering of the long edges.

4. It has no gloss, and yet only a very thin weather scale.

None of these characters is known, as yet, in the Paleolithic group. It is the coarseness of the chipping which gives this knife a Paleolithic aspect. It seems, therefore, better to allow coarse chipping in the Early Neolithic epoch than to disregard all these features and put the specimen as yet in the Paleolithic epoch.*

Loss of a Glossy Surface.

The idea of a specimen having lost a gloss is confirmed by one of those numbered 5603. It is a pink chert "core." An old surface has no gloss, but a smooth surface and a very thin weather scale. Where this is intersected by an Early Neolithic chipping the

*It was found later that this knife falls in the Early Neolithic, along with tomahawks and others [Early Neolithic No. 1].

later chipped sufaces are glossy—distinctly glossy, the material being the same. The older surface, therefore, may be Paleolithic, and probably was once as glossy as the Early Neolithic sufaces are now.

Pink Chert.

Mr. Brower, in his note book No. 20, March 11 and 24, 1902, declares that the peculiar pink chert is "in place" in southern Missouri, on the head branches of the Osage river, especially on Sac (Sauk) river. He says he procured 6000 of these (pink) chert implements. In course of examination these have not yet been found.

The Tomahawk People.

April 23, 1912. It is becoming more and more probable, as I get familiar with the specimens, that not only most of the specimens are Early Neolithic, extending through several Glacial epochs, but that the "tomahawk people," the typical people of the ancient Quivira region, were not Paleolithic, although "pre-Glacial" with regard to the Wisconsin epoch, yet post-Glacial with regard to the Kansas epoch, and hence Early Neolithic.

April 26, 1912. I notice that the tomahawks, characteristic of Mr. Brower's "tomahawk people" (Nos. 5673 to 5678) are distinctly less weathered than the specimens which I have classed as Paleolithic. As Mr. Brower says in his notebook that these tomahawks are found on the tops of terraces outside of the Kansas moraine (yet in the Kansas valley), and as these terraces are (questionably) due to the damming of the

river by the Kansas ice,* the tomahawk people are for that reason also probably post-Kansan and hence not "Paleolithic" according to the definition of Paleolithic in this paper. That is as it should be, and leaves the Paleoliths still as pre-Kansan, and harmonious with their weather patina. (See further p. 96).

Incipient Scraper.

June 21, 1912. I find a number of large flakes, suitable for making scrapers, with a flat surface on one side but not mono-beveled to a scraper about the broader end (5731). These are Early Neolithic. Some of them are in part chipped about one end, or nearly all round, as if the scraper idea was incipient in the mind of the maker, but not yet actualized in a perfect implement.

Neolithic "Turtle."

I find also a Neolithic large turtle (5725), or "blank", coarsely chipped and indistinguishable from the Early Neolithic except by the freshness of the chipping.

Limitation of the Terms Paleolithic and Early Neolithic.

June 25, 1912. In renumbering the specimens (with ink) I find a specimen (5397) which has the general aspect of an Early Neolithic but the culture of Paleolithic time, in that its design appears to have been no higher than to *get an edge*, and its three edges show that the fabricator was satisfied with that accomplishment, for they have been battered by use This, and

*The terrace on which these tomahawks are found may date from Tertiary time, the river having been the discharge from a Tertiary lake that existed in western Kansas. (Aug, 1912).

a few other facts observed give me a suggestion that some re-arrangement is needed in the definition and limitation of the terms Paleolithic and Early Neolithic. v. p. 104.

This (5397) I find is one of a group of six, which are registered "pieces or cores". But the rest of the group do not show edges which have been used like the edges of this one. They are approximately globular, and have been used apparently as chipping hammers.

Paleolithic Culture Continued into Neolithic Time.

June 28, 1912. In going again through those first classed as Neolithic I find:

1. Many are Early Neolithic—judged by the gloss which more or less covers them.

2. Of tomahawks, a few are Neolithic, judged by the absence of gloss.

3. Of large leaves, or turtles, which prevail in Early Neolithic and Paleolithic time, three are found without gloss and are apparently of Neolithic time,—although one of them has remaining a little calcareous scale, indicating the action of a Glacial epoch. They are completed specimens, and not "blanks". They have been battered by use. They are No. 5307.

From Nos. 2 and 3, foregoing, it seems necessary to infer that Paleolithic culture did not cease with the introduction of higher art. It seems to be necessary to admit the actuality of a series, or succession of stages, such as has been shown by Holmes, in the development of a perfect or well-finished implement wholly in Neolithic time. But that does not do away with Paleolithic implements made in Paleolithic time.

Paleolithic art would naturally and necessarily precede Neolithic. It is not reasonable to assume that Neolithic art, in its perfection, sprang at once into activity. It seems to have required a long period of time for the growth of sufficient skill to fashion the Neolithic implement from the Paleolithic, but it is evident that every Neolith was fashioned from a fundamental Paleolithic shape. The fact that only Paleolithic forms are found with the patina of age proves that the Neolithic forms were developed later, and probably by improvement on the art of the Paleolith. We have to admit, then, the existence of rude (i. e., Paleolithic) forms both in Paleolithic and Neolithic time, and we cannot exclude them from any stage in the development of the art of stone-chipping. The important thing is to admit their basal importance in the development of the art, whether in the time required for the growth of the art, or in the fabrication of an individual specimen. Mr. Holmes has demonstrated the latter, but has seen no evidence of the former, or at least when he has seen it he has refused to admit its validity. It seems to me that one is the subsidiary complement of the other, and that when fully and properly understood neither can exist without the other. That is, if we have a Neolithic implement that fact implies an earlier Paleolithic form, not only for that implement itself but also for the commencement of the art. Or, if we have a Paleolithic implement, that fact implies, according to the known progress of man in the art of stone chipping, the existence sooner or later of a "finished" Neolithic implement, and that Neolithic implement may be made all in

one day from the rude Paleolithic shape, or it may require the patient labor and development of thousands of years. It is only by the weather patination, *ceteris paribus*, that Paleolithic blades can be distinguished from the rude Neolithic. V. also p. 98.

Tomahawks Have Never Been Withed.

There are reasons for believing that the so-called tomahawks have never been mounted by having a withe bound around them for handles.

1. They show no wearing where such withes would have been bound about the tomahawk.

2. They show a battering along the lateral edges which extends along the most of the length of the specimens, such battering descending into the notch where it is to be presumed the tying descended. (Many tanged points, however, show the same.)

3. There is no evidence of a groove on the side of the specimen where the withe might have grasped the body of the specimen between the notches.

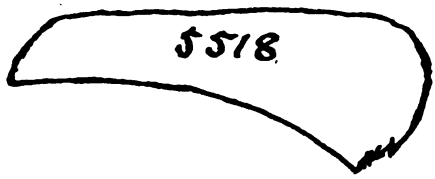
4. Sometimes the notches on the sides are not opposite each other, and sometimes they are obsolescent and even wholly wanting.

The Scraper.

June 29, 1912. As to the scraper, there are some variants from the typical form which tend to the belief that we do not know yet with certainty the purpose of this implement, viz:

1. There are many that show an under-chipping at the bevel end, so as to cause a retreating of the out-

line along that end backward, along the flat surface. The profile of such is like this figure:



2. There is occasionally one that has both ends mono-bevelled, at the same time one being under-chipped.

3. Some are so small that they would have been of no use as scrapers of hides, and some of these small ones are under-chipped. The smallest I have noted is exactly 3/4 in. long.

Different Signs of Age.

June 30, 1912. Besides a glossing which comes on some specimens (I may say most specimens) with age, there is also a roughness which denotes age. This appears on specimens that are light colored (5552), and is due to a variation of internal grain. When such specimens are broken freshly, or cut, such variation of internal grain cannot be observed, but on weathering there is developed, on the surface, along with an imperfect scattered fine porosity, a gentle roughness which brings into relief the firmer and coarser elements of the rock. There seems to be no difference in the chemical composition. It is only a difference in the manner of siliceous aggregation. Sometimes the shapes of fine fossils can be seen in this roughened rock, and sometimes this roughness and this glossiness can be seen on the same specimen, the glossiness

being usually on a variety of dense blue-gray rock. (5678)

Continuation of Paleolithic Culture.

July 9, 1912. Referring to what is stated on pages 94 and 95 respecting the continuation of the Paleolithic culture as evinced by leaves or turtles, into Early Neolithic and even into Neolithic time, I think further that it would be warrantable to state as a general principle that: All Paleolithic art was perpetuated, or may have been perpetuated, into Early Neolithic and Neolithic time, and all Early Neolithic into Neolithic, and hence that the progress of stone-chipping was essentially a continual introduction of new forms and higher skill without the necessary loss of any of the older forms. This I think can be shown respecting the following kinds: leaves, tomahawks, scrapers and knives.

Beyond the latitude of the Kansan moraine it would be inevitable that artifacts showing all stages of patinization should be found, and that, too, on the same sites, while on the northerly side of that moraine a pre-Kansan artifact would be found but rarely and still more rarely inside the Wisconsin moraine. (V. plates XV and XVII.) Between those moraines a long period of time elapsed, such that great advance in the art of stone-chipping probably was made. Some of these intermorainic artifacts, i. e., the oldest of them, ought to show a nearer approach to the pre-Kansan artifacts in both culture and age, than others, and some of them, if the foregoing general principle be true, ought to approximate toward Neolithic and even ought to grade,

in both respects, into Neolithic. This would be illustrated by artifacts found southward from the glaciated areas, while to the northward from the great moraine belts, there would be necessarily more or less evident steps of improvement in culture, *pari passu* with less and less patination, on passing from the outside of any moraine to the area within it.

Left Handedness of Early Neolithic Man.

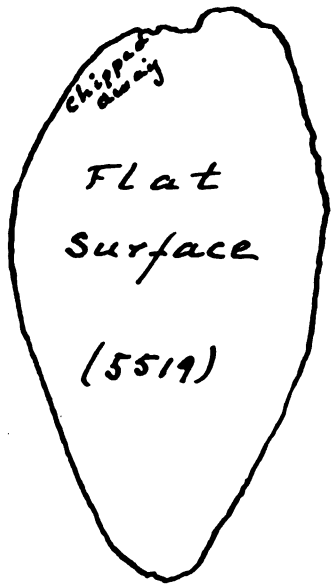
As to scrapers, again, in addition to what is written on page 96, I have discovered evidence that the underchipping mentioned is due to rough usage as an implement, viz: (1) it is most commonly a little to one side from the center of the implement, as if the tool were held in the hand, and in use had been turned somewhat to one side to give it effective application—and I have noticed that it is most frequently to the left of the center when viewed perpendicularly on the flat surface, as if the user held it in what we know as the right hand. This may indicate that the aborigines were left and right-handed. (2) I have seen the same kind of underchipping extending along one side of the tool more than half way to the other end, evidently due to use, there dying out into little irregular chatter-marks or checks.

Hence it appears that this under-chipping was not caused by a systematic flaking, by a hammer or other flaking tool, but by a rasping or scraping of the edge of the scraper on some substance.

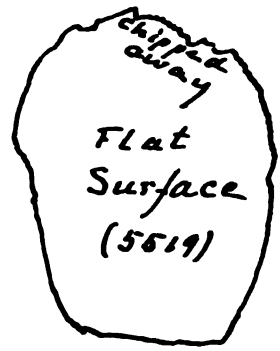
(3) Where this under-chipping appears there is a recession of the edge back upon the body of the scraper

so as to distort the otherwise symmetrical outline, this proving that the under-chipping was not a step in the making of the implement, but was in some way superinduced after the implement was finished.

July 11, 1912. I have examined a lot with reference to the right or the left hand use of the scraper.* In making the selection I discarded those which showed only a central undercutting, and also those which manifested no noticeable difference as to right or left hand use. I found 39 which indicated a right hand use, and 19 that indicated use with the left hand, and probably 10 that showed no difference. The figures below illustrate this.



Showing Right Hand Use.



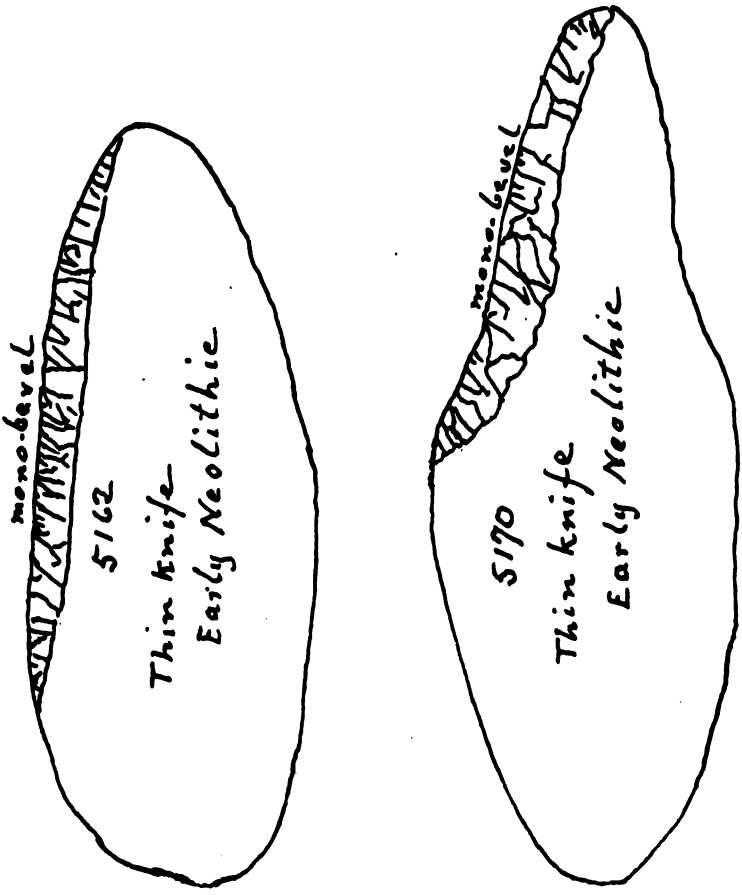
Showing Left Hand Use.

*"On Lefthandedness in North American Aboriginal Art." See D. G. Brinton, Am. Anth. vol. IX, p. 175, May, 1896.

UNIV. OF CALIFORNIA

Imperfect Harahey Knives.

July 23, 1912. One of those knives numbered 5162, while having the same shape as the others of the same number, has one side for two-thirds of its length mono-beveled, like a Harahey knife thus:



Imperfect Harahey Knives.

The whole knife has a semi-gloss, and on that character is put with Early Neolithic implements.

The mono-beveled edge is thicker than the edge at any other place.

Still another (5170) is mono-beveled on both edges at one end and is not beveled throughout the rest.

About one-half the length is thus mono-beveled. This is doubtfully Early Neolithic, the gloss being less pronounced. Compare plate XIII.

Different Rates of Patination.

On a large specimen (5199), shaped like an elongated (small) turtle, the oldest chipped surface is partly on a blue-gray and partly on a light-gray chert. The light gray by long exposure has acquired a scale which is cream-white and glossy, its thickness being quite distinct. That portion of this fracture surface which extends over the blue-gray chert is not glossy nor noticeably patinated by decay or change of color. It has acquired simply a dirty tinge by which it appears a little lighter colored than a fresh fracture. Both these have been broken by Early Neolithic chipping, and the same Early Neolithic surface runs in the same manner, from the light-colored chert to the blue-gray. A similiar difference appears: that part of the Early Neolithic surface which is on the light gray chert is well glossed and is distinctly Early Neolithic, as I have classified many specimens, but that part of the Early Neolithic fracture which runs on to the blue-gray chert is not perceptibly patinated in any way, and might easily be called Early Neolithic, or even Neolithic No. 2. (Page 104).

From this it is apparent not only that a blue-gray chert requires much longer time to be altered so as to acquire a patina, either of gloss or of alteration, but also that Paleolithic specimens of blue-gray chert may be so well preserved, even when favorably exposed for patination, that they show no evidence of greater age than Early Neolithic. These differences are of fre-

quent occurrence, introducing another element to be observed in judging the age of any specimen.

Early Neolithic Preferable to Pre-Neolithic.

July 29, 1912. Putnam, in a letter from S. Eliot, Maine, suggests the term *Early Neolithic* instead of Pre-Neolithic, which presumes *prior* to Neolithic. It is a good suggestion, and his term can be applied to those artifacts that show Neolithic culture but are so old as to be glossy. That would leave *Neolithic* still for those not glossy but of Neolithic culture. Then the term Pre-Neolithic can still be applied to those glossy specimens which have Paleolithic culture, but which still are not plainly Paleolithic in patination. We would have then:

1. *Pre-Paleolithic* and *Early Paleolithic*, those having a thick white or brown patina of alteration, with or without a gloss, and with little to denote culture. Some natural jointage or other old surfaces are Pre-Paleolithic.

2. *Paleolithic*, those having less alteration patina but usually a glossy surface. On the light chert a glossy white scale of alteration is present and cotemporary with a scant brown scale of alteration on the blue-gray chert with little or no gloss. This embraces those large rude leaves or turtles, which are abundant and frequently broken so as to embrace but one-half, and many irregularly shaped fragments that have an edge, or two edges, which have been battered by use. This is sometimes difficult to separate from the next.

3. *Pre-Neolithic*, those having no noticeable alteration patina but are glossy, with Paleolithic culture.

4. *Early Neolithic*, those having Neolithic culture and a distinct gloss, without alteration patina.

At first these were classed together as Pre-Neolithic.

5. *Neolithic*, having, with Neolithic culture, no patina of any kind; also all polished or ground implements of Neolithic culture.*

I find that the stages of culture can hardly be assigned to definite Glacial epochs, so far as shown by the Kansas specimens. It is possible to say now only that the great change in culture exhibited between the Pre-Neolithic (and Paleolithic) and the Early Neolithic was probably incidental to the oncoming of the Kansan Glacial epoch. The Early Neolithic seems to extend from after the Kansas epoch to the post-Wisconsin, apparently grading into the Neolithic culture.

August 24, 1912.

VI. WORK OF DR. W. ALLEN STURGE, OF MILDENHALL, ENGLAND.

August 23, 1912. By mail I have received from Dr. W. Allen Sturge, of Mildenhall, Suffolk, England, a copy of Vol. 1, Part 1 of the "Proceedings of the Prehistoric Society of East Anglia", published in 1911. It contains the presidential address by Dr. Sturge, October 26, 1908: "Flint implements of Sub-Crag Man", by J. Reid Moir; A report by a special committee to enquire into the question "whether the Sub-Crag implements had been chipped by natural or by human agency"; "The Chronology of the Stone Age", by Dr.

*Later it was found necessary to divide Early Neolithic into No. 1 and No. 2, and the same is true of Neolithic artifacts.

Sturge; "Animistic forms in certain flints, showing human work", by Col. W. Underwood, and Resumes of business and scientific meetings, 1908 to 1910.

Of these papers that which specially concerns American archeologists is the "Chronology of the Stone Age", by Dr. Sturge, pp. 43 to 105, read January 13 and March 22, 1909. The stone age, as well as the Glacial geology with which it is intimately associated in England, according to the author, is well represented in America, and as Glacial geology is also abundantly represented in America, it becomes a very pertinent inquiry whether the two are as intimately associated in America as in England.

It affords the writer great satisfaction to know that in many things—indeed in all essential results—Dr. Sturge's investigations, so far as they run along lines parallel to those of the foregoing chapters confirm the writer's conclusions as to the intimate association of man with the Ice-age, throughout its extent, from its beginning to its end. The district in which Dr. Sturge found his Glacial implements is near the morainic border of glaciation, and has sometimes been water-flooded and sometimes ice-covered, introducing a confused succession of boulder-clays, brick clays and gravels, some of the earlier deposits having been pushed aside and over-run by later ice sheets. It was the effect of some of the later ice sheets upon some of the implements, which attracted attention. The implements are "striated" in the same manner as the hard rocks in the northern part of Minnesota. These striations were found to vary considerably. He discriminates six classes and illustrates them by beau-

tiful photo-plates. He correlates these classes with differences of patination. Of patination he makes the following remarks:

"A flint has been worked into some shape suitable to his needs by a man at one period; has been abandoned by him at his death, or when he has done with it. It has lain on the ground for a sufficient length of time to become more or less deeply patinated. At some subsequent period it has been picked up by another man who, though living at a time long posterior to the first worker, is still in about the same stage of civilization as this first man; and who works the flint to suit his particular needs. The new work will be quite unpatinated, as the patinated surface will be partly removed by the process of chipping the flint into the new shape. This second man will then abandon the implement in his turn, and it will again lie on the ground exposed to patinating influences. When picked up today by the collector, some thousands of years after the last user has thrown it aside, the work of the second period may or may not have undergone surface change. But in any case the surface change will be wholly different from that of the work of the first man, and we see two well-defined series of surfaces on the same flint, the one on the facets due to the older man's work and the other on the facets of the later man's work. This applies both to Paleoliths and to Neoliths, though it is perhaps more common in the case of the latter. A study of a large number of such doubly patinated implements, in conjunction with a study of an even larger number of singly patinated implements, is of the greatest service in helping us to ar-

rive at a good working knowledge of the value of patina in relation to age." P. 48.

With the "striation" due to glaciation and the associated patination, the author unites *lustre* and *"iron-moulding."* The former is the glossiness, and the latter the streaked distribution over the surface of some artifacts, of limonite, both described by the writer in the foregoing discussion of Kansas artifacts.

All these features, and the time involved in their production, the author puts into "Neolithic" time. He considers that Paleolithic time, while antecedent to Neolithic, was composed of two great epochs, "Drift" man and "Cave" man, of which the former was the earlier. Back of Drift man was the age of the Boulder-clay, and earlier still, in the Pliocene, at the base of the "Crag", flint implements showing glacial etching. The whole time involved in the production of the successive Glacial epochs, and hence of the existence of man, he finds to accord with the Crollian hypothesis, the lastest glaciations, or series of glaciations, having occupied a period of time extending from 300,000 years ago to 100,000 years ago. There was some "nine or ten recurrences of glaciation, corresponding to the occurrence of winter in or near the aphelion, with relaxations of cold conditions in the intervals, during which winter was in or near perihelion."

There are several important "conclusions" brought out by Dr. Sturge to which attention should be specially directed, viz:

1. As regards the nomenclature of the successive epochs of the Stone age, the author's distinction be-

tween Paleolithic and Neolithic is based on the accident of *where the implement was found*,—if on the surface it is Neolithic, if in the gravels it is Paleolithic, always presuming that the gravels were deposited prior to the fabrication of any of the surface-found implements. That, however, is very questionable. To the writer it seems quite likely that many of the patinated implements found on the surface, and especially in the little fresh-cut gorges, or "side valleys" that descend from the Elveden plateau, were originally embraced in gravel beds that form the sloping sides of those little valleys, and that they have been brought to light and concentrated by the erosive action that formed the little valleys. In general, throughout the region, this transformation of Paleoliths to Neoliths, by change of pose through the action of surface disturbance of the gravels, is likely to have taken place. In that case many of the Neoliths described by the author may be actually Paleoliths. In short, the accident of where the stone is discovered, whether in gravels or not, is of no value whatever, unless considered in connection with its cultural characteristics and its patination.

2. It will be noticed that in the term "Neolithic" the author embraces what in the foregoing discussion the writer has put in the Early Neolithic, and that he includes in the term "Later Neolithic" essentially what the writer has called Neolithic. It is probable that the occurrence in Europe of a "Bronze age", which has not been recognized in America, is to some extent responsibe for this discrepancy.

3. It will be noticed also that all of the characters which by the writer are considered Paleolithic are included by Dr. Sturge in his term Neolithic.

4. On the presumption that the operations of the Glacial epoch, and epochs, would have been in Europe much like the same in America, it seems remarkable that the gravels produced by the tumultuous waters should have been considered by Dr. Sturge of so much later date than the boulder clay, or the boulder-clays. In America it is a settled conclusion that each boulder-clay had its cotemporary gravels and sands, and, at lower levels when the waters were gathered in ponds and lakes, had also its brick-clays. It is by the careful and prolonged study of these, and especially of their distribution and superposition, that in America it is well established that there was a succession of Glacial epochs. It was by the wash and destruction of the boulder-clays by the discharged waters that were deposited the gravels, sands and brick-clays. Hence, in general, the boulder-clays are to be considered not as antedating the Glacial period, and so evidence of glaciations earlier than what Dr. Sturge has put in his "Neolithic", but as actually coeval with his "Neolithic", some boulder clays being earlier than others. Owing to the confusion which was introduced in the drift by the successive glaciations, and especially about the moraines, the unraveling of the dates of any human artifacts found in it becomes a very complicated problem in all places where different ice-sheets have covered the country.

5. The characters of striation which Dr. Sturge has found on numerous Neoliths, and has so minutely

studied and described, he takes as evidence of successive glaciations of the country. To the writer this seems to be unreliable evidence. An observer who had never seen striation on the hard rocks of the Archean, might suppose the depth of the striae, the criss-crossing of the fine striae, the confused polishing striation on quartzose surfaces, could be attributed to differences of pressure, and hence to successive sheets of ice of different thickness. But it is not an uncommon thing, in northern Minnesota, to find two or three, perhaps all, of the different characters described by the author, on the same rock surface, within the area of a few hundred, or even a few scores, of feet, and plainly due to a single glaciation. The hardness, the position and the movements of pebbles embraced in the bottom of the ice all vary, as the movement proceeds.

6. The author's description of the valley of the Lark where it crosses, at nearly right angles, the "gravel-topped ridge" which makes Warren Hill, High Lodge and other gravel deposits as far north as Maid's Cross Hill near Lakenheath, is so minute and natural that it warrants, perhaps, the presumption, on the part of a stranger, that a different history from that given by the author would fully apply to the facts he has described, and would be in consonance with known principles of Glacial geology. Briefly, the writer is impressed with the similarity of the surface features between Mildenhall and the Elveden plateau, to those of many localities in America where, near the farthest limit of the latest ice-sheet, streams of water were numerous and turbulent, flowing from the ice. Such waters gathered in gorges in the ice, and in the same

gorges, by surface wash and gravitation, was concentrated the drift which was on and in the ice. The running stream carried away all it could carry, leaving only the coarser parts of the drift in its bed. On the complete disappearance of the ice-sheet the bed of the former ice-bound river is marked by a ridge of accumulated gravel and sand and stones of all sizes, which rises, in places, nearly as high as the adjoining plateaux. This ridge is sometimes continuous for several miles, but is frequently broken by little cross-valleys such as those named "the valley", "the vale", and "the gully", on Dr. Sturge's "map of the vicinity of Icklingham". It is quite reasonable to suppose, therefore, that the great gravel ridge mentioned, on which so many human stone artifacts have been found, is of the nature of a *kame* formed not far back from the margin of a great ice-sheet, in the bed of a rapid river which flowed southwardly from the ice-field of one of the great glaciations, such ice-field extending toward the north an unknown distance. The fact of the existence of disrupted, brick-clay and of till mingled sporadically with the gravels of the ridge, is very interesting, and as the clay contains Mousterian artifacts there must have been an earlier period of quiet and non-glaciation when the country about Mildenhall was habitable, or at least a spot where brick-clay could be gathered and could receive occasional human contributions of stone implements; though it is entirely conceivable that such brick-clay did not much antedate the epoch of its disruption. During the time of the formation of this great gravel deposit, composing the "kame", if this explanation be correct,

the drainage was southward, and it would be likely that enormous areas of "overwash" sand and gravel would be found in the country lying to the south and southeastward from Mildenhall.

7. In the opinion of the writer there is no way to separate the Paleolithic age into two successive parts, such as the *drift* and the *cave*. But on a geographic basis there might be a ***Drift paleolithic man*** in northern latitudes where glacial streams formed copious gravel deposits in their bottoms which later by general desiccation of the country became terraces, and a *Cave* man in southern latitudes where Glaciation did not occur, or even in Glacial latitudes where habitable caves escaped the course of the glaciers. But obviously, the Drift man was cotemporary with the Cave man, at least with the later part of the Cave man period. In general, therefore, the man of the caves had a longer dynasty than he of the terraces, and such dynasty probably extends back further than any recognized glaciation. It may have been during some inter-glacial epoch that the Cave man of Le Moustier occupied the region of Suffolk and dropped his implements into some quiet waters The facts described by the author pertaining to the Warren Hill locality obviously show the following:

(1) The Mousterian age, in Suffolk, showing interlaminations of till with brick-clay which contains humanly shaped implements, must have been nearly cotemporary there with a general glaciation.

(2) The deposits were thrown out of horizontality by a later ice-sheet.

(3) The later ice-sheet furnished the gravel of Warren Hill and of High Lodge.

(4) The Mousterian Cave man of Mentone was contemporary with a Mousterian Drift man in Suffolk.

Still, notwithstanding these critical objections to some of the conclusions of Dr. Sturge, which seem to show the necessity of extensive remodeling of his chronology of the stone age, it is to be admitted that archeologists are much indebted to him for his critical discussion. British archeologists, as well as American, will be spurred to a vigorous study of patination, and to a closer search for implements in gravel pits and terraces. Whether finally the succession of events will be found to coincide with the theory of Croll it is too early to predict.

VII. CLASSIFICATION OF KANSAS ARTIFACTS BY CULTURE STAGES.

The Simplest Artifact an Edged Tool.

It is plain, from a careful inspection of the Kansas artifacts, that the simplest culture of aboriginal man was sufficient to produce *only an edge.* In many cases he used pieces of an irregular shape on which there happened to exist, in whole or in part by his agency, an edge which could be made to serve his purpose. He may at first have found, ready to his hand, some nature-fractured pieces. From these, either by accident or design, new edged pieces were broken off, and he found that by very little effort he could produce others. Some of those which he produced are coarsely chipped, and large, and have but little to indicate any design as to shape; but he certainly acquired the skill

and the habit of giving his simplest implements some conventional shapes. Those which are called *"leaves"* or *"blades"* or *"turtles"*, having a general ovate or ovate-oblong outline, and a longer dimension of about four or five inches are common. But the sizes extend from a length of ten inches, illustrated by specimen numbered 5206 (page 12), and a width of six and three-fourths inches, down to less than two inches in length.

Others were left more nearly in the shape that the natural fractures gave them, with the addition of some marginal trimming, and this gave rise to a large series that are squarish and also to those that are polygonal and some that are celtoid. These indeed probably antedated the ovates, but they must have continued side by side for a long period.

Implements of these shapes date from Paleolithic time, as shown by their patination, but they do not cease with Paleolithic time. The same idea is expressed in implements of later date, and even Neolithic time. It may be that the so-called Neolithic "blanks", found in great numbers in caches in Ohio and other states, embody the primal idea of the Paleoliths of the ovate and ovate-oblong shapes. It is not alone by the patination that the Paleolithic specimen is distinguished; but, along with the oldest patination, the *completeness* of the implement according to the purpose of the fabricator is shown by the fact that nearly all of them have been dulled in Paleolithic time along their edges by use in the hand of their owners, such dulling also being patinated.

Knives.

The use of ovate, or squarish, edged tools seems to have provoked the trimming of their outlines into a more elongated tool, to which the term *knife* has uniformly been applied. These knives were about eight inches in length and about an inch and a quarter, or somewhat more, in width. They are essentially the same that by Mr. Brower was called "Quivira knife". For the most part they are not sufficiently patinated to be placed unequivocally with Paleolithic culture, only one having been found (p. 90) which certainly dates from the same age as the foregoing, and that one is not a well-shaped implement. All the rest, so far as observed, fall into a later stage. They are about parallel-edged, well chipped, well shaped, with a slight curvature, and one end a little narrower than the other, but both ends terminating rectangularly, (or approximately so) and in nearly all cases have a distinct glossiness but no patina of alteration. Many were broken and we have the parts.

This Early Neolithic Quivira knife was the completed instrument, but the term "knife" has to be applied to a number of (Paleolithic) implements which were chipped only coarsely, the general shape of which would allow of their being called lance-ovate or lance-oblong. These are sometimes eight or nine inches in length. They show edges battered by use, and could have been used only for purposes identical with the purpose of the perfected tool, i. e., for some coarse cutting or hacking. These have been put into Early Neolithic No. 1. The shape varies still further, one

end being left rough and large, as if it furnished a more convenient hand-grasp, thus grading into the gouge. With still further variation in shape the ends, (one or both) were dressed to a point more or less obtuse, and also more or less acute, the latter making an instrument which must have been in constant demand, either about the camp or in the capture of game by hand. These nicer forms (like the Quivira knife) are Early Neolithic No. 1 and Neolithic No. 2.

But the term *knife* must be given a still wider application. Indeed it is applicable not only to numerous almost shapeless implements which plainly have been used for simple cutting with a single hand-stroke, but to others that are well-trimmed and shaped but whose shapes are not always such as to cause them to be classed as knives. This includes many that have been called spears or arrow-points. Their use as knives is shown by their battered edges, and might be inferred from their size which sometimes plainly precludes them from the category of spear or arrowpoint. Some knives are short, and evidently derived from scrapers by trimming their edges, and some are single, simple flakes which have not been trimmed at all. The great majority of these more variant forms are found to fall into Early Neolithic time, but they were continued in Neolithic, and to the very latest of American stone-cutting.

The "Harahey knife" is a special type which developed in Early Neolithic time. It has four mono-beveled edges, one-half of the knife being alternatively beveled in the direction contrary to the bevels on the other half, the general outline being diamond shaped.

In some cases only one-half of the knife was thus mono-beveled, and occasionally only one-fourth or three-fourths. Such lozenge-shaped knives manifest a high degree of skill and workmanship and it can hardly be doubted that normally they would have continued into Neolithic time. v. plate XVIII.

Gouges.

It is plain that any stone, with any kind of a projecting angle, could have been employed as a gouge, and such gouge might grade into a rough drill. Some such are shown on plate VI. They began in Paleolithic time, in their simplest form. Some such have distinctly pointed, or beak-like terminations, with but little effort manifest to dress the larger end further than to reduce it to convenient size for the hand. It is impossible for modern man to conceive of the uses to which the aborigine could have put such a crude tool, but modern man cannot question its existence and its usefulness to its owner. The most recent of stone gouges are concavo-convex and show by their form the purpose for which they are made, and along with their higher culture they express an improvement in the grade of work which they are designed to perform, commensurate with the differences which distinguish Neolithic man from Paleolithic. So far as the Kansas specimens convey any idea of the simplicity of the wants of Paleolith man, they would allow us to suppose that the first stone gouge, as well as the primeval stone knife, and the first sharp edge used by him, were nature-formed, due to such jointing and separating under the influence of moisture, heat and

cold, as are well-known effects on long-weathered chert. Such knives he occasionally found on the slopes where a chert bed had an outcrop exposed to the elements. It was by use that he learned that new edges were formed equal in sharpness to the old ones. (A practiced eye can easily distinguish the natural fractures from the artificial.) It must have required, however, no very long periol of time for primeval man to discover that by chipping a stone he could form edges and points far superior to those which he found ready-made.

Scrapers.

When aboriginal man began to chip stone so as to improve on nature-formed pieces, he found that his chips themselves constituted useful implements. They had sharp edges as well as points. Some simple chips were used as knives without further fashioning. They were also the first scrapers; but the conventional *scraper* was the result of some want not before felt and it came into use in Neolithic time, apparently in Early Neolithic. They never have the Paleolithic patina of alteration in any form. They were made from those flakes or chips which were struck off by a single blow of the hammer-stone, having a curving outer surface and an inner surface less curved, or nearly straight. The ictus-bulb is usually preserved at the smaller end of the less-curving fracture-surface. The smaller end is also thinner than the larger (with very few exceptons) and rarely shows any secondary chipping. But the larger end is extensively re-chipped, the chips all having been taken in the same

direction so as not to affect the less-curving fracture-surface, but so as to run out on the outer (older) surface. This repeated chipping about the end gives the flake a mono-bevel at that end and maintains an edge which lies constantly in the less-curving surface of the flake.

Such scrapers occur in great numbers in the collection. In size they vary from three-quarters of an inch in length to about three and a half inches, by far the larger number being about two and a half inches long. There are, however, nine specimens (5531) which vary remarkably from the normal. Their length is about six inches. They are not so noticeably mono-beveled at the larger end but are more uniformly chipped all round, the flaking along opposite edges intersecting along the center of the older (convex) surface so as to form a more or less continuous ridge or keel. These edges have been dulled by use. The demand for such scrapers, if they were used for dressing hides, may indicate the existence of the buffalo at the time they appear. They are classed, according to their patination, as both Early Neolithic and Neolithic No. 2.

Occasionally a scraper is found which is mono-beveled at both ends, and also one that has the sides (edges) nearly parallel. There are also implements which approach near the scraper in size and form, which were not made from single flakes, but have been re-chipped in all directions so as to reduce them to their present outlines. Indeed, abnormal forms occur in all the classes, and, as has often been remarked, the classes run together so that sometimes it is im-

possible to assign individual specimens to any class without some qualification.

Tomahawks.

The origin of the tomahawk (5197, plate XIII) must have been about coeval (though perhaps a little earlier) with that of the scraper,—i. e., in Early Neolithic time. The implement here referred to is quite numerous in the collection. Its most usual (and hence the normal) form is what will here be considered. A flattish piece of chert was chosen having a length of about four and a half inches. The thickness was less than an inch and its width about two inches. One end was frequently a little wider than the other, and likewise a little thinner. With this piece the tomahawk was made by chipping about the wider end so as to produce a rough central edge. The narrow end being left almost in a natural state, and usually quite rough and coarse. In addition, two broad depressions, or notches, were formed, one on each lateral edge, by chipping into the outline more deeply at points about opposite to each other. These shallow depressions were made usually not at the center of the lateral edges, but at about two-thirds of the distance between the extremities, and nearer the non-edged end of the implement. Such notches, or indentations in the outline, suggest the idea that the implement had been wrapped in a wooden or rawhide withe and had been wielded with a handle somewhat in the manner of the modern war-club.

Variations from this normal type consist of: larger size, reaching more than six inches in length and a

corresponding width; both ends edged*; the width not much greater than the thickness; the lateral notches or indentations very slight, or even wholly imperceptible; the lateral notches not opposite each other. The tomahawk represented on plate VI (5219) is a variant form, smaller than the type.

This form of tomahawk seems to have continued into Neolithic time,—i. e. post-Wisconsin—judging by the occurrence of specimens whose chipped surfaces show no glossiness. It may have been hence the progenitor of the modern war-club. Still, its form is so different from that of the modern withed war-club that there is room to suppose that its purpose is not yet understood. If it were withed by the aborigine it would have formed an effective and dangerous weapon, either in the chase of the large beasts with which he was cotemporary or in war against his human enemies.

Leaves or Blades.

Allusion has already been made (p. 114 and plate VII) to Paleolithic leaves, blades and turtles, but in Early Neolithic and Neolithic time these became more finely chipped and more ornate as to form, and more nearly representing the implements which at present in most collections are thus named. One such may be seen photographed in plate XII (No. 5556), and another (No. 5135) in plate XIII. The use of these implements is problematic. They could serve as knives when their edges were thin enough, as well as

*Moorhead, in "The Stone Age in North America" has illustrated some tomahawks, saying that they are found frequently west of the Mississippi, in Nebraska, Missouri, Arkansas and Iowa. Op. Cit. II, 188.

scrapers. There is reason to suppose that they were useful in so many ways that for the hunter, as well as for the squaw who remained most of the time at the camp, they were consequently in demand and perhaps were carried as vade mecums as faithfully as a civilized man carries his pocket knife. It is noticeable that some of them have been worn away by use on the edge at the larger end, as exhibited by the photograph seen on plate XIII.

As with other implements, the "blades" were subject to great variation, becoming nearly circular (5802) especially the Paleolithic, or elongated, with sub-equal extremities (5110), and also grading into pointed celts. (5115 of plate IX). They are sometimes thick and rough; and their earliest types are exhibited by Nos. 5765 and 5231 of plates XII, as well as by several others shown on plates VII and VIII.

Celts.

The earliest, at least the roughest, identifiable *celt* (5792) differs widely from the typical form. It is an implement about seven inches long, originally embraced between natural jointage planes, on three sides, and on the other apparently chipped off so as to approach a Paleolithic edge, tapering roughly to a blunt point. The butt end is terminated also by a straight jointage plane approximately at right angles to the others. This does not date back to Paleolithic time. Its latest worked surfaces show little or no glossiness. It is composed of dark gray chert, a kind which does not take a gloss nor a weather-scale easily. Its surface carries a scattering deposit of limonite

("iron-mold" of Sturge), which may be considered an indication of considerable age (V. p. 107). At the most this specimen can be referred to Early Neolithic time.

Its culture would take it back farther than that but its comparative freedom from weathering and patination requires that it be put into Neolithic or Early Neolithic time.

From this rough form of celt, which may be considered, perhaps, only a small form of those represented in plates III and IV, (5212 and 5213), there are so many stages of alteration that they cannot be illustrated, nor even noted. There was an easy gradation, as to size and form (v. 5868) from the foregoing to the Neolithic type, i. e., to the polished celt, or ungrooved stone hatchet, or ax. There are some which seem to be allied to the tomahawk, already described. Others appear to verge toward the *blade* and others toward a pointed *knife* (5867). There are none that certainly ante-date the Kansan ice age, but there are many that show by their patination that they are not much younger. The celt idea, therefore, was one of the primitive concepts of aboriginal stone art, and it finally resulted in the Neolithic polished celt and the grooved-ax celt.

On plate XVIII is shown a celt from Kansas (5715) which closely resembles the Paleolithic found some years ago at Newcomerstown, Ohio, by Prof. W. C. Mills to which attention has been called widely by Dr. G. F. Wright. That was from a gravel pit supposedly of the Wisconsin Glacial age. This was found at or near the surface, beyond the morainic limit of the Kansan Ice age. This has dates of four chippings, as

evinced by differences of patination, viz.: (1) Pre-paleolithic or Early Paleolithic, having a thick, white weather-scale and perhaps not artificial, seen only on one side; (2) Early Paleolithic, having a brown, glossy weather-scale, less thick than the last and certainly artificial, showing the wavy undulations of chip-fracture; (3) a thin white weather-scale, perhaps a remnant of (1) where (1) has been roughly chipped away, appears only on one edge. It may be Paleolithic, however; (4) highly glossy Early Neolithic surface covering the most of the specimen, ornamented by wavy concentric undulations. This specimen is of dense blue-gray chert. It shows the effect of considerable use at the broader end and along both lateral edges.

5052 (of plate XIII) represents a handsome smaller chipped celt of Neolithic date, slightly dulled at the broader end and along the long edges. It is of dark blue-gray chert and free from weathering effects. Between this and that first mentioned (5792) is a wide gap, but it is filled by examples which by slight variations show the lineal descent of one from the other.

The purpose of the celt which dates from Early Neolithic time was not that of the Neolithic celt, which is sometimes given the name *ungrooved ax*. It shows no evidence of having been used as an ax or hammer. It is never grooved, nor notched, as if it had been attached to a haft or handle. It is usually not battered by use at either end, and if so battered at all it appears to have been accidental, or subsidiary to that which is seen on the long edges. The long edges are sometimes so rounded by use that all semblance of an "edge" is lost. It is on such specimens that can be

CELT SHOWING THREE W

E289
(4)
(3)
(2)
39/5
Kansas Valley

seen a little battering at the ends. The use of such celts seems to have been more like that of a knife, although still it may have been more like repeated light blows than like strokes of a knife.

Explanation of Plate XII.

This plate shows the extremes of culture, evinced not only by the differences of patination but by the different types of implements. The specimens illustrated are from the Kansas valley, and chiefly from the vicinity of Alma, in the Mill Creek valley, one of the tributaries of the Kansas river.

The oldest artificial surfaces are seen on No. 5765 and No. 5231. The former is specially valuable as a demonstration of two dates of chipping on the same specimen, both of them so old as to have acquired a patination. The older patination almost surrounds the piece, showing that it had about the same size and form in Paleolithic time as at present. At certain points this patination, which is a dirty-brown (or drab) and glossy scale, covers the edge on opposite sides, and on one side the edge was worn as by use in Paleolithic time. (at X). These old surfaces contrast strongly with the later surfaces which indicate, not only by the type of the specimen but also by the glossiness, that they were formed in Early Neolithic time. Taken alone, in all its features, this specimen indicates that the purpose of the later chipping was almost identical with that of the earlier, and that the art of the later fabricator was not much in advance of that of the earlier.

No. 5231 is a large irregular implement made from a slab of light-gray chert. Its earliest chipped surfaces are marked Paleolithic, and its later Pre-Neolithic. The contrast between the surfaces of different dates is not so great as in the last, but sufficiently marked to warrant the designations given. This specimen is somewhat dulled with use at two points on the edge. One is at the top, and is not shown because the chips and the battering are too much on the other side. The other is at the extreme left, and can be seen in the photograph. The thickness of the weather-scale that covers the Paleolithic surfaces is seen distinctly along the dotted line. It is white, and about as thick as card-paper.

No. 5577, a bi-pointed, gibbous *knife* of blue-grey chert, covered by a dull gloss. This gloss, as well as the higher art manifested, denotes a length of time between the making of the two specimens already mentioned and the making of this, which was sufficient for the introduction of an entirely new people. It is believed that the Kansan ice epoch separated them. The term Early Neolithic is applicable, therefore, both from the Glacial date and by the state of culture exhibited.

No. 5290 represents a typical *scraper* of Early Neolithic date, mono-beveled at one end, dulled along the long edges and especially at the broad end by use in the left hand of the owner. This type of implement continued into Neolithic time.

No. 5556. A perfect ovate-oval *blade*, which shows two dates of chipping, Early Neolithic and Neolithic, and at the point and at the lower right hand, a part of

Pre neolithic
5765
Kansas Valley
paleolith-ic
paleolith
5231
Kansas Valley

EXTREMES OF CULTURE. PAGE 125.

a Pre-paleolithic weather scale which has a white color and a thickness of one-sixteenth part of an inch.

No. 5450. A Neolithic *arrow point* with a stout tapering tang, having no gloss and no weather scale, of blue-gray chert.

Explanation of Plate XIII.

Specimens from the Kansas valley. Actual size. (See pp. 115-125).

No. 5135. Leaf, ovate, thin, worn away at the larger end by use, gray chert, Early Neolithic.

No. 5802. Circular leaf, roughly finished; has a dull gloss, but no weather scale; slightly limonated; perhaps Early Neolithic, mottled with gray and dark blue-gray.

No. 5110. Short knife, or leaf, or scraper, chipped to form on all sides, a variant of the typical scraper. Compare Nos. 5222, 5223 and 5225, of plate VI, and pp. 18 and 19.

No. 5197. Typical tomahawk of the "tomahawk people". The entire edge is chipped from the base up, and shows but little damage by use. The surface is streaked with limonite on the side photographed (patina (g), p. 11), and that side has less weather patination than the other; Early Neolithic.

No. 5715. Celt, showing four dates of working, described on page 107.

No. 5052. Handsome chipped celt of Neolithic date. This consists entirely of drak blue-gray chert, and hence may have a greater age than its fresh appearance denotes.

No. 5624. "Harahey knife", mono-beveled three-fourths. That part not mono-beveled is marked X. This sample is smaller than the average. It shows the patinae (b), (d) and (g), the former two only on the reverse side. In the immediate vicinity are five empty square cavities indicating that the patina (g) may have been derived from the oxidation of pyrite. The emptied square cavities were then filled in part by the black substance which forms patina (d).

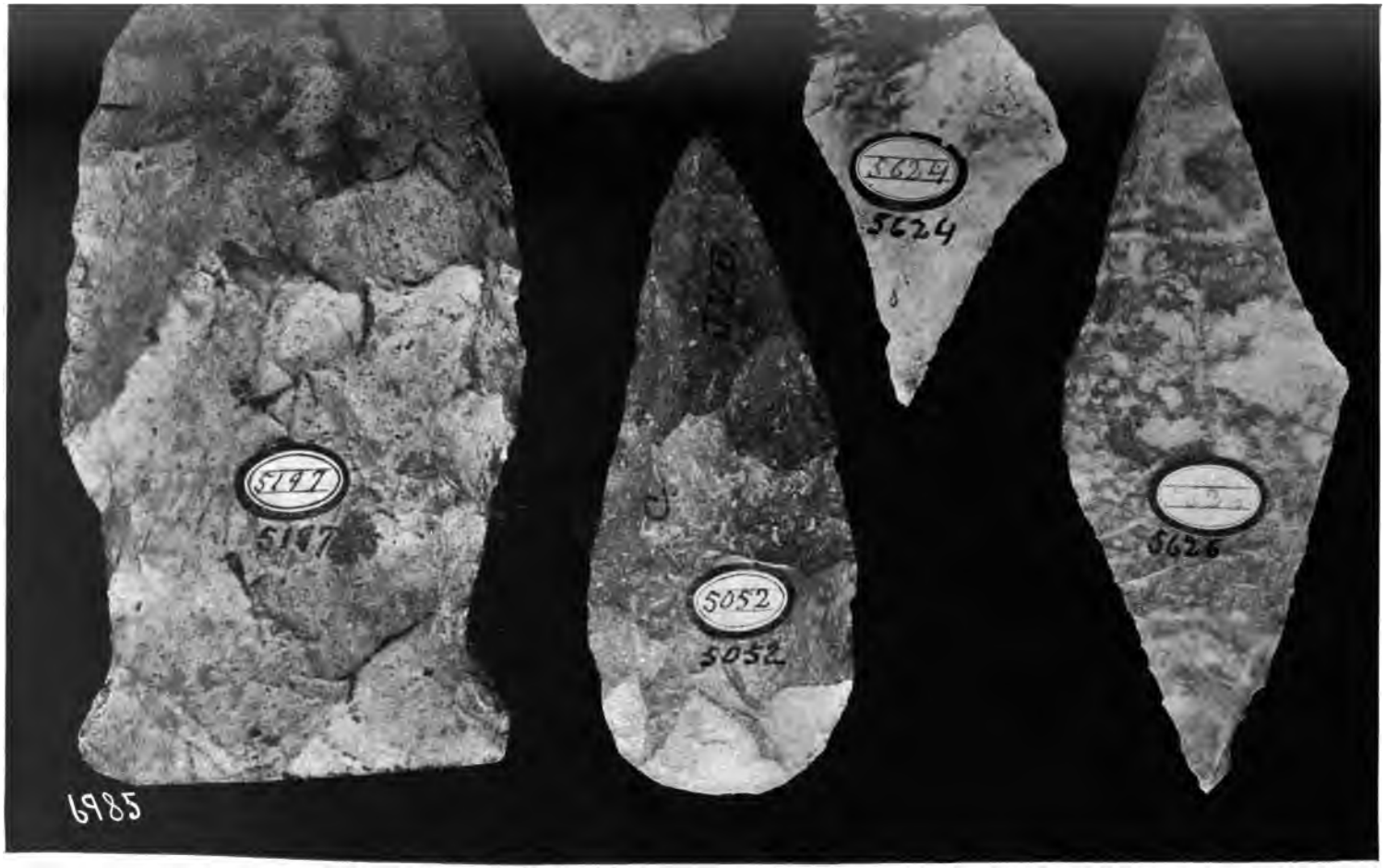
No. 5626. A well-glossed, perfect "Harahey knife", of dense, mottled, pink and dirty-white chert, probably dating from (late) Early Neolithic time, a little smaller than the typical size.

Points. Neolithic No. 1.

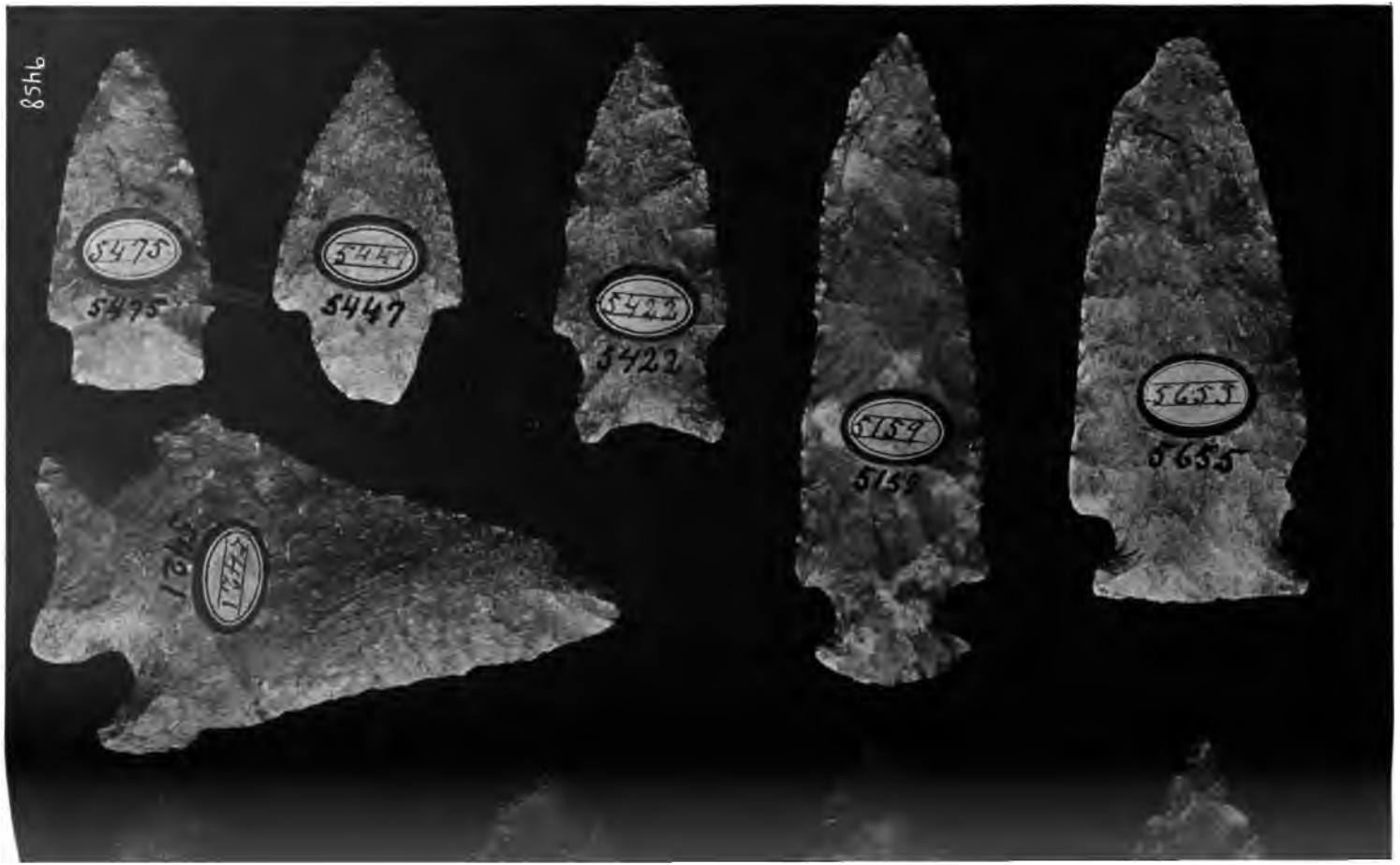
The points show some interesting features. It has been intimated already at several places in the course of the investigation of the Kansas artifacts that not only was there a notable change in the skill evinced by the specimens in passing from the Paleolithic to Early Neolithic, but that the Early Neolithic culture grades into Neolithic. It has also been stated that the large majority of all the specimens are of the Early Neolithic stage, as evinced by the shiny gloss that covers them, and that comparatively few are of Neolithic date. It has also been stated that the Early Neolithic specimens belong apparently at different dates between the Kansan and the Wisconsin ice-epochs. It remains now to call attention to a group of *points* which differ from the Early Neolithic points in several important respects:

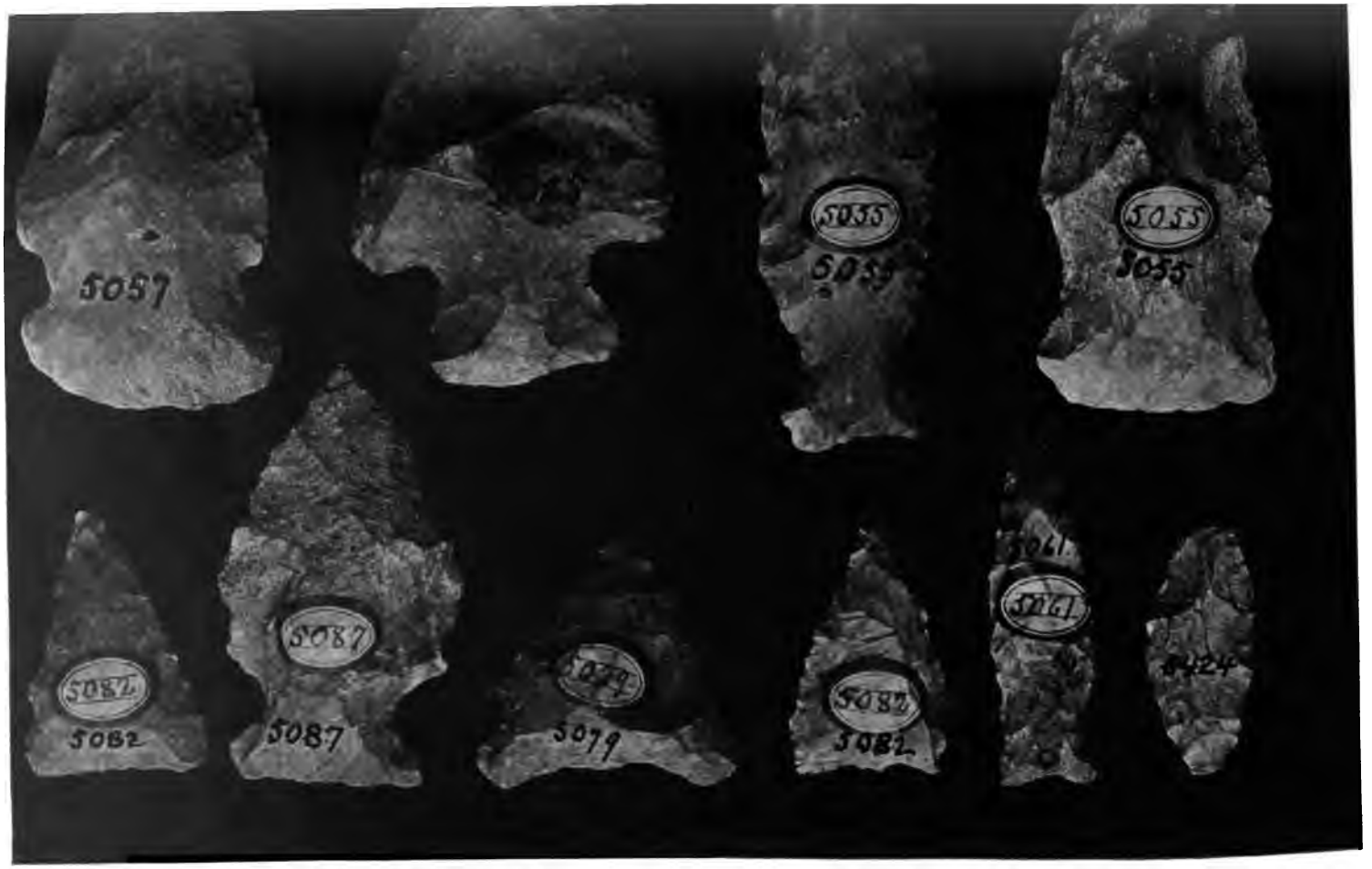
1. They show but little glossiness—as a rule they are free from gloss and distinctly Neolithic.

5135
5715
Kansas Valley



PALEOLITHIC AND EARLY NEOLITHIC NOS. 1 AND 2. PAGE 127.


5475
5475
5447
5447
5422
5422
5159
5159
5655
5655
1345
1345



CONTRASTING EARLY NEOLITHIC CULTURE WITH THE (SUPPOSED) NEOLITHIC NO. 1. PAGES 129, 131.

2. They have a coarse chipping, almost recalling Paleolithic art, and they are usually larger and thicker than the glossy Early Neolithic type (No. 2).

3. They are quite numerous in the collection, between forty and fifty, and as a group present a striking contrast with the Early Neolithic (No. 2) points, which are not only glossy and thin, but of delicate shapes and sizes, as well as finely chipped.

These two classes are shown on plate XIV.

If we may depend upon the criterion which has been followed hitherto in the investigation, (the different weather effects) these coarser points indicate a late intrusion of coarser culture into the area of the Early Neolithic culture, or else a succession of a people of coarser culture upon the spots that for a long time had been the habitat of a higher (Early Neolithic No. 2) culture. There are several considerations, based on the specimens, which rather indicate the latter of these alternatives: (a) The sudden appearance of the fresh points. (b) The non-discovery, or at least the comparative absence of points of Early Neolithic No. 2 culture that show the freshness of these of coarser culture. There are a few points (only fourteen so far as the collection has been examined) which have been classed as Neolithic which show the Early Neolithic culture and delicate trimming, but ten of these are only fragments and two are variants which have uncertain relations. Practically the *points* knives and scrapers of Early Neolithic No. 2 beauty of form and finish ceased in Kansas with the introduction of this coarser type. Several of those objects shown on plate XI are manifestly contemporary products of this new culture.

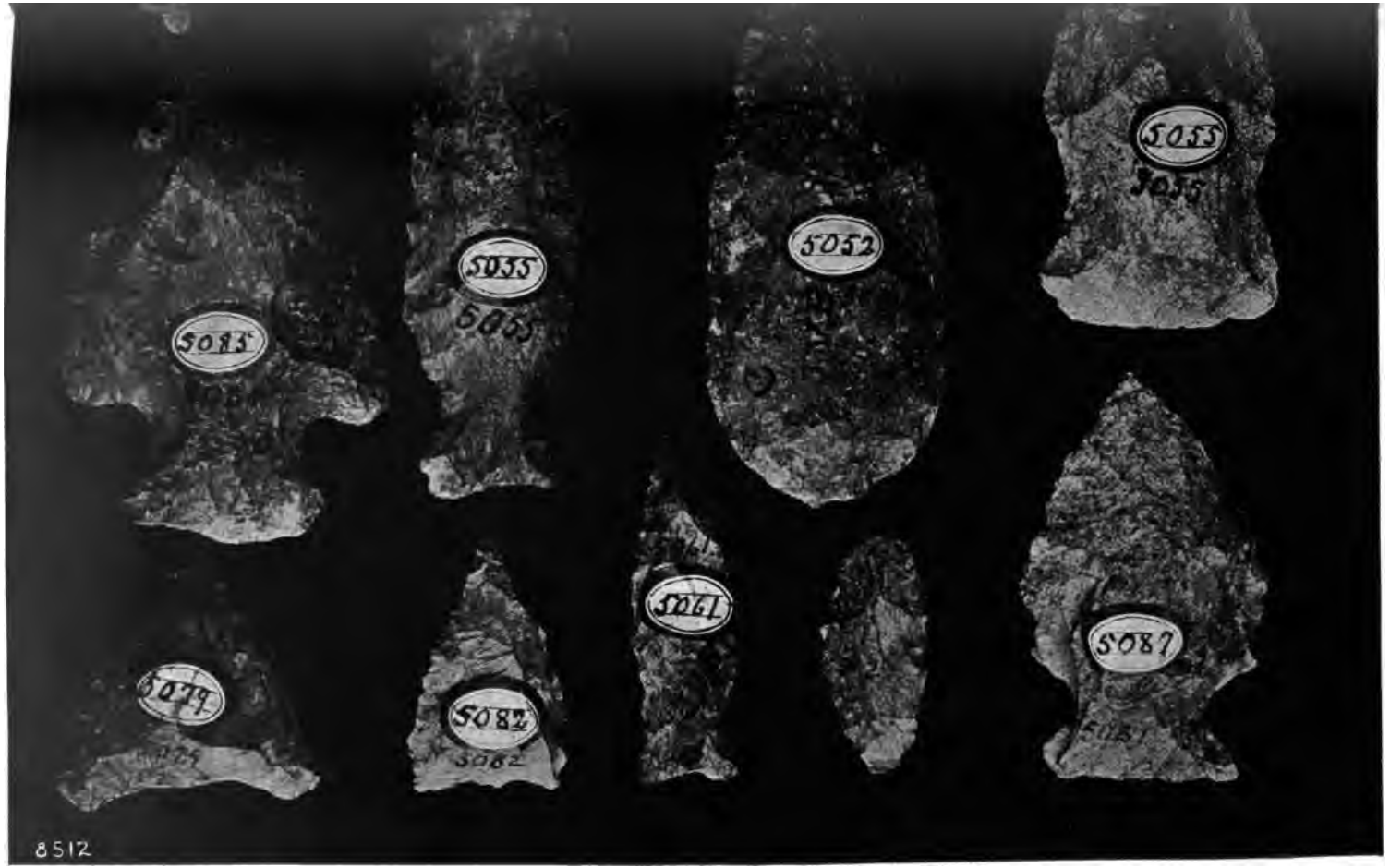
There is reason to believe that the so-called Paleolithic "blanks" and probably the Paleolithic types of leaves and knives or blades which, in Kansas, show the freshness which certainly separates them from Paleolithic time, as already discussed on p. —, can be referred, in large measures, if not wholly, to the people that introduced these coarse points.

This change from Early Neolithic culture No. 2 to what may be called, at present, the *real Neolithic* (or Neolithic No. 1) is so marked that the event must be considered one of first rank in the history of the American aborigine, and its cause must be looked for amongst those of first rank.* Every archeologist, as well as every geologist, will revert at once to the agency of the Wisconsin Glacial epoch, as the prime cause of this change. Whether these coarser artifacts were produced while the Wisconsin epoch prevailed, and by a people who may (in that case) have resembled the Esquimo, or were introduced after the recession of the Wisconsin glaciers, is an interesting inquiry, but one which at present it is perhaps too early to attempt to answer. Future investigations will probably throw light on it.

The idea presented above, based on a consideration of the *points*, to the effect that the Early Neolithic culture No. 2 was expelled on the introduction of the coarser points is not borne out by an examination of the leaves and knives; but it seems more probable that the former of the alternatives mentioned on p. 129 was the actual condition on the introduction of the coarser artifacts. That is, it seems that a people of more rude skill in stone-chipping was co-temporary,

*The intrusive culture is illustrated by plate XIX.

5071
5073
5072
5074
5094
5057



INTRUSIVE—NEOLITHIC NO. 1. PAGE 130.

at least for a time, with those who fabricated the nicer implements. The facts seem to warrant this conclusion, since amongst the knives and blades of Early Neolithic No. 2 culture are fourteen thin, finely chipped blades that are so fresh that they certainly belong in the Neolithic group, as to date. These may not have been made exactly cotemporary with the coarser implements (Neolithic No. 1); but they may have preceded or followed them, in the Kansas valley, by several hundred years. If the intrusive coarser culture in the Kansas valley was in any way connected with the Wisconsin ice epoch, and if the rest of the country toward the south were still inhabited by the people of Early Neolithic No. 2 culture, there could not have been a long-continued occupation of the Kansas valley by the intruders; but in turn, on the amelioration of the climatic conditions, the southern people would necessarily have resumed possession of the chert beds as the intruders retired toward the north. The chert of these nice thin blades is of the same quality as that of the coarse points.

Explanation of Plate XIV.

Early Neolithic No. 2 and Neolithic No. 1 from the Kansas Valley, actual size, illustrating the intrusive culture (see also plate XIX).

No. 5475. Point with a broad square tang, Early Neolithic.

No. 5447. Point with a tapering stout tang. Early Neolithic.

No. 5422. Point with a stout, eared tang. Early Neolithic.

No. 5159. Point or knife with a short, edged tang, Early Neolithic.

No. 5655. Point or knife with a broad, edged tang, Early Neolithic.

No. 5421. Point, broad, barbed, having a tang with a concave edged base. Early Neolithic.

The foregoing are thin, finely chipped, and glossy with age.

No. 5057. Point, thick, rough, with a stout broad tang, which has a convex, edged base. Neolithic No. 1.

No. 5085. Similar to the last, but having a narrow tang. Neolithic No. 1.

No. 5055. Point, narrow, notched like the next but having a tang narrower than the body. Neolithic No. 1.

No. 5055. Point, with broad stout tang, that is separated from the body of the implement only by broad, shallow emarginations, edges dulled, apparently by use. Neolithic No. 1.

No. 5082. Point, tangless, base edged and slightly concave. Neolithic No. 1.

No. 5087. Point, thick, coarse, tang edged. Neolithic No. 1.

No. 5079. Point, triangular, coarse, base concave. Neolithic No. 1.

No. 5082. Point, triangular, base nearly straight. Neolithic No. 1.

No. 5061. Point, or drill, base of broad tang concave. Neolithic No. 1.

No 5424. Bi-pointed point, small, ends blunt. Neolithic No. 1.

VIII. AN ARCHEOLOGICAL RECONNOISSANCE.

The writer spent the month of May, 1912, in an archeological reconnoissance which extended through Nebraska, Kansas, Missouri, Ohio and Wisconsin. About one-half of the month was occupied with an examination of the valley of the Kansas river as far westward as McPherson county, the purpose being to ascertain the relation of the artifacts to any terraces which might accompany that stream or any of its tributaries, and thus to get a guide as to the relation of the artifacts to the successive ice-epochs. The remainder of the month was devoted to an examination of archeological collections at Topeka, Kansas City, St. Louis, Cincinnati, Columbus, Flint Ridge, Cleveland, Chicago, Milwaukee and Madison, with a view to learn whether those collections contained any of American paleolithic date. The following notes contain the results of this trip so far as they have archeological import. The writer was accompanied and guided at different places by Prof. J. E. Todd, of Lawrence, Judge J. T. Keagy, of Alma, and Mr. B. B. Smyth of Topeka, and desires to thank them for their cordial assistance.

THE KANSAS VALLEY.

Elevations in the Kansas Valley.

The following list of elevations is from Henry Gannett's Bulletin of the United States Geological Survey, giving railroad elevations in the United States. The figures expressing elevations above the sea level seen on the various depot buildings of the Union Pacific

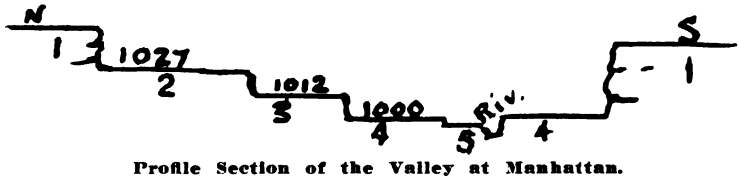
railroad are quite different from and usually lower than Gannett's, sometimes more than fifty feet.

	Authority.	Feet Above Sea Level.
Abilene	U. P. Station	1154
Alma	Chicago, R. I. & Pac	1061
Alta Vista	U. P. R. R.	1432
Assaria	U. P. R. R.	1277
Belvue	U. P. Station	959
Beverly	U. P. Station	1326
Blaine	U. P. Station	1505
Blue Rapids	U. P. Station	1105
Chapman	U. P. Station	1113
Cow Creek	U. P. Station	1606
Detroit	U. P. Station	1135
Dwight	C. R. I. R. R.	1500
Emporia Junction	A. T. & S. F. R. R.	1138
Enterprise	A. T. & S. F. R. R.	1137
Eureka Lake	U. P. Station	1023
Fort Riley	U. S. C. & G. S.	1064
Hanlon, Neb.	U. P. R. R.	1205
Harveyville	A. T. & S. F. R. R.	1113
Herrington	C. R. I. & P. R. R.	1328
Junction City	U. P. R. R.	1078
Kansas City	U. P. R. R.	760
Kansas Falls	U. P. R. R.	1090
Lawrence	U. P. R. R.	828
Lindsborg	U. P. R. R.	1241
Manhattan	U. P. R. R.	1012
Marysville	A. T. & S. F. R. R.	1497
McPherson	A. T. & S. F. R. R.	1497
Minneapolis	U. P. R. R.	1255
New Cambria	U. P. R. R.	1098
Ogdensburg Sta.	U. P. R. R.	1044
Randolph	U. P. R. R.	1052
Ramona	C. R. I. & P. R. R.	1436
Republic	M. P. R. R.	1495
Salina	U. P. R. R.	1226
Smoky Hill Buttes	U. S. S.	1580
Solomon	U. P. Sta.	1171
Stockdale	U. P. R. R.	1029
Topeka	U. P. R. R.	880
Wabaunsee	A. T. S. F. R. R.	1020
Wamego	U. P. Sta.	898
Waverly	A. T. & S. F.	1127
White City	C. R. I. & P. R. R.	1469
Zeandale	C. R. I. & P. R. R.	997

The Big Blue Valley. Descending the valley of the Big Blue river it was noted that at Wymore the town is located on a flat lying between Indian creek and the Big Blue river and rising about 50 feet above the creek. But the town also ascends to an upland which is about 25 or 30 feet higher toward the west. This upland is also apparent along the southeast side of Indian creek. The whole upland (and flat) is covered with a loess without any stones. This terrace-like flat is originally due to the Kansan drainage. Since the loess was deposited the Big Blue river has cut into it. The terrace contains much gravel and sand, and serves as a reservoir that affords the water supply of Wymore. The Burlington Depot, at Wymore, is fifteen to eighteen feet below the top of this terrace.

A similar terrace accompanies the Big Blue below Blue Springs to Barneston, and to Oketo which is apparently on a lower terrace, and to Marietta. Marysville is on a lower terrace, about 40 feet below the upland at the East. Below Marysville this lower terrace abuts upon the strike of the rock which rises about 15 feet still higher. Randolph is on a cultivated high flood plain.

Manhattan. On the south side of the river the rock cliffs rise more or less abruptly from the river or from the flood plain, with no distinct remains of any "second bench", or terrace, for several miles in both directions. But on the north side is an evident and extended upper bench, embraced within the outer rock hills. The situation is as below:



Profile Section of the Valley at Manhattan.

No. 1 is the upland, perhaps 150 to 250 above the river, composed of limestone and shaly strata, giving a rolling topography on the south side of the valley, with much stone in the soil, making a grazing country, but seldom considered first class as farm land. Probably the residuum of decay of the Carboniferous. No drift boulders seen.

No. 2 is a loam, or loess, terrace, on which the north part of Manhattan stands.

No. 3 is a terrace about 15 feet lower than No. 2, and on it is the Union Pacific depot. In 1903, the river covered this terrace at a memorable flood, when the Gillett house was approached by boats. The business part of Manhattan is on this bench.

No. 4 is the immediate flood plain.

No. 5 is the present river.

The Agricultural College is on terrace (2) at the northwest corner of Manhattan.

At a quarry near the top of the upland, north of Manhattan, the light buff limestone and the shale contrast singularly with the maroon-colored stoneless, sticky gumbo by which they are overlain. The shale seems not to have affected the gumbo in any perceptible way though in immediate contact. The gumbo was therefore transported to its present place. Indications of this gumbo were seen at several other places, even in Nebraska, near Holmesville. It covers also the upper terrace (No. 2) at Manhattan, and is evidently a great and important member of the superficial deposits. So far as seen it is the oldest member, but still at all places seen it may have been secondarily

redeposited by the drainage incident to the valley during some part of its earlier history.

Wamego. Eastward from Wamego, on the north side of the river, is an extended area of flat land, which appears to be the bottom land of the present river, as far as St. Mary's, making fine farms. On entering within the moraine at Wamego, the distant bluffs become more distant and apparently lower, and the said plain broader. The plain with only slight undulations continues to Lawrence. The drifted country looks like Minnesota in drift topography. Where, near Buck creek, the line of moraine crosses from the south side to the north side of the Kansas river, there can be seen on the north side a series of very stony hills ranging toward the northeast, and a little further southeast are outcrops of apparently a sandrock in the low bluff, a formation which must run below the great Carboniferous limestone seen at Manhattan.

On the south side of the river, opposite Wamego, is an emphatic and distinct terrace which rises above the wide cultivated flood-plain about 30 feet. This flood-plain was covered by water at the time of the flood of 1903, as at Manhattan, and doubtless corresponds here to that level. The Wamego railroad station was not flooded, by six or eight feet. This upper bench consists of a light red silt, or loess, but there was no opportunity to examine its structure.

Alma. Many specimens have been collected in the Mill creek valley, and especially from the neighborhood of Alma. Not only were the collections made by Mr. Brower augmented by Judge J. T. Keagy, of that city, but through his guidance and later by his recent

industry, a considerable addition has been made not only to the knowledge of the region, but to the Museum of the Historical Society. The recent visit was made in company with Prof. J. E. Todd, of Lawrence.

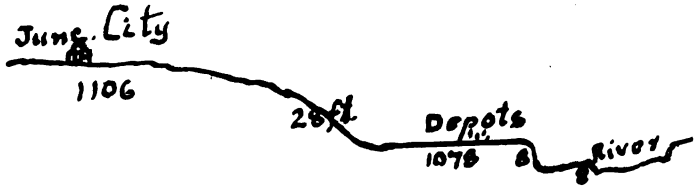
Judge Keagy's collection is installed in "the museum," a building lately acquired by the city, of which it forms the greater part of the exhibit. The specimens are mainly of Early Neolithic date, but a few are Paleolithic, while some show portions of pre-Paleolithic surfaces. There are small and elegant arrow points, drills, many scrapers, "Harahey knives," spear points (notched), and some modern hammers and mill-stones, also one polished celt. The museum also contains the collection and books of the late E. A. Kilian, of Alma. It was at this city, Oct. 29, 1901, that was held the first meeting and the organization of the Quivira Historical Society.

At one mile and a half north from Alma, on Hendrick creek, was found recently a locality rich in Early Neolithic artifacts. We walked over the plowed land but found only a few flint spalls. They are on a loess plain, or terrace, about twenty feet above the creek. They are outside of the Kansas moraine, and the date and cause of so copious a loess along the valley are not apparent, but perhaps it is due to the damming of the Mill creek by the Kansan ice, the moraine of which lies about six miles to the northeast from Hendrick creek at this place. It would be in that case a part of the lacustrine plain left by the Glacial Mill lake, so named by B. B. Smyth.*

*Kansas Academy of Science, Twenty-ninth Annual Meeting, 1897, p. 100.

It was found, on visiting the place, that the site of Paleolithic (or Early Neolithic) artifacts at one and three-quarters miles southwest from Alta Vista had no relation to any terrace., It is in a valley of a small creek, but, aside from a variable present flood-plain, the creek has no evidence of any constant higher stage, and the site appears to have been on one of the higher remnants of this shifting flood-plain. The valley has rock bluffs that are some distance back, and rise about 75 feet above the creek. Chert fragments are abundant, occasionally blue, but mainly long-weathered and brown or buff yellow. Both kinds show signs of artificial chipping rarely. It is also apparent that the chert chips formed by natural disintegration take conchoidal surfaces and have been accumulated under the action of ancient pre-Glacial drainage, locally along stream valleys, as seen abundantly at Alma, at levels at which now no stream can reach, thus capping remnants of old rock terraces or of alluvial flood-plains that may date from any Early Glacial or even pre-Glacial epoch. Such gravel of old chert at Alma is seen to reach the thickness of four feet.

Junction City. The descent from the flat on which the business center stands (Bardell House) is not abrupt but irregular and gentle. Indeed this flat is itself somewhat undulating. The lowest cultivated flat of the Republican river is about 8 feet above the river, and about 8 feet below the depot flat.



Profile Section of the Valley at Junction City.

Fort Riley. Is a tract of 19,800 acres lying on both sides of the Kansas river. The site of the fort proper is on an undulating ascent which rises to the lower part of the limestone bluffs, where rock and chert are crushed by machinery. The terrace conditions at Junction City are the same as at Manhattan. On the farm of Robert Henderson, southeast from Junction City, the main (upper) terrace rises 30 feet above the lowest cultivated flood-plain and consists of red clay. At the bottom, however, at the river level, may be seen unmistakable northern drift in the form of quartzyte small pebbles, and smaller rounded quartzytes apparently derived from a conglomerate. These, however, may not have been derived directly from the Potsdam here, but may have entered first into a conglomerate at the base of the Cretaceous existing further west and thence transported down the valley by some later agency. One pebble is 3½ inches in diameter. Mr. Henderson also showed me a red quartzyte about 7 inches in its longer diameter. It was not water-rounded, but had been battered all over, one side (edge) having been used evidently as a knife-ax. It was found on the plowed bottom land. He has also a small red mano-stone, or upper millstone, which is oblong and battered all about the edge as if used for a hammer. He also stated that he had found a red quartzyte pestle. These facts indicate that formerly red quartzyte was not an uncommon fact on his farm, or that these have been brought from the morainic region further east by the aborigines. Still the gravel above mentioned, evidently in part

from the Potsdam, rather indicates that this is on the feather edge of the Kansas drift.

Abilene. The plain on which Abilene is situated was flooded in 1903. It extends south to the river, about a mile and three-quarters, and also about three-quarters of a mile further south, where it is terminated by the great (upper) terrace which rises forty feet, more or less, above this flood-plain. There are no rock bluffs visible on the south side. Building rock is hauled from Enterprise. This flood-plain is about 15 feet above the average normal flow of the river.

On the north side of Abilene the upper bench is broken, but it contains sand which is used for cement. This sand, on careful examination, affords but slight evidence of ingredients derived from the northern drift. It embraces, besides white quartz sand, very much of ferruginated (Cretaceous) scales, also chert which is mainly rotted, and lime concretions, and a few larger, dark red or brown quartzyte pebbles which, however, cannot be connected with the Potsdam with any certainty. This upper bench, on the north side, extends so far north that it forms the general upland of the country, and it is stated that at least for 18 miles toward the north there is not much variation. The surface descends in a rather undulating manner to the lower bench, and that also descends somewhat to the river.

Between Junction and Abilene there seems to occur some important underlying cause which determines not only the greater hight of Abilene, but also the disappearance of the outer (limestone) rock-bluffs. This upper bench, which now rises and spreads so as to

constitute the general upland, is apparently that which has been noted already at Junction, Manhattan and elsewhere, but the composition is much more sandy. It is about 40 feet above the flood-plain on which Abilene is located, but owing to moderate "dissection" its actual average level is indeterminable, although so far as can be judged by what has been seen it seems to be a waterlaid formation.

New Cambria. At New Cambria the flood-plain is broad, and the railroad stations are on it. Toward the north, at a distance of a mile and a quarter, sandstone bluffs appear, rising about 75 feet. The rock is scaly and probably Cretaceous. Round the bases of these bluffs are remnants of what may have been an alluvial terrace, which rise about 30 feet above the flood-plain.

Toward the distant south, across the river, are buttes of some rock formation, which are probably Cretaceous.

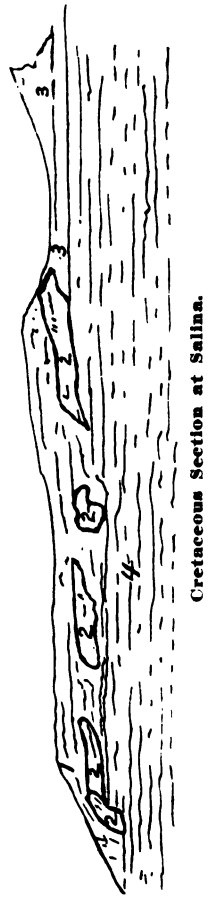
The 1903 flood-plain is about 10 feet above the present (high) stage of the river.

Salina. East from Salina, across the Smoky Hill river, is an upper terrace, rising above the great terrace already noted, which is of Cretaceous sandstone and sandy, scaly, mostly thin-bedded rock; and about two miles still further southeast is a line of buttes also probably Cretaceous. The terrace mentioned has an undulating upper surface, somewhat dissected, but its top is still alluvial or lacustrine. It rises 50 or 60 feet above Salina station. It appears to correspond to what was seen at New Cambria. It furnishes not only mortar sand, but some brown and purplish-brown

pieces that somewhat resemble Potsdam. Otherwise, about Salina the country is very flat and at the same level (1,226) as the railroad station, in all directions so far as can be seen, and liable to flooding as in 1903.

The upper surface of the Cretaceous terrace at Salina is composed of a red sandy soil, at least in part, but it becomes (below) a red clay and a lighter-colored clay.

At the brick-plant, east of the river, which is on the flood-plain, is an exposed bluff of Cretaceous rising above the flood-plain about 50 feet, of which the figure adjoined illustrates the structure.



Explanation:

1. Red, or light red clay, or loess, vertically jointed, in places sandy ..... 5 ft.
2. Dislodged masses of hard, rusty sandstone, waterworn..1-3 ft.
3. Sandstone like No. 2 but apparently in place .....1-3 ft.
4. Blue shaly sandstone and shale easily disistegrated ..... 50 ft.

The shaly sand and shale are used in the plant, makng a red-brown hard brck, mottled with buff. The hard sandstone masses are crushed by machinery and sold for cement works.

There is a rather coarse silica-sand obtained in great quantities in a "pit" toward the north from

the brick plant, situated in the lower plain, the sand of which is obliquely stratified, in part, by some rapid current, probably of the river itself in its earlier history. This sand no doubt was derived from the Cretaceous.

Assaria. Is on a broad plain, but toward the west (a little south) are seen some buttes, about three miles distant.,

Lindsborg. At Lindsborg the great plain (the flood-plain which was covered in 1903) extends indefinitely, the only visible exception being the Cretaceous buttes, already mentioned, toward the west. The extent of this plain is surprising. It seems to be within the area of the great lake described by Udden.* This great plain was practically covered by water in 1903, but "it did not go up into town." An old settler (J. M. Wilson) asserted that the flat at Lindsborg was not generally covered in 1903. The Indians state, however, that about 100 years earlier they went across the prairie in canoes from Dry creek to Smoky Hill

*V. **American Geologist** VII, 340. Prof. Udden describes a great "trough" extending southward from the valley of the Smoky Hill river cutting through the main watershed of the state and connecting with the Arkansas valley. This has been revealed by borings, etc., for its presence is not indicated by the surface topography, the country being level as a lake. The materials in the southern end of this trough are: yellow marl, volcanic dust, clay, sand, gravel, in descending order, with variable thickness and composition, and with pebbles of crystalline rock in the gravel, associated with fossil wood and Mammalian bones. The Pleistocene in this trough is at least 75 ft. thick, with volcanic dust at a level of 1430 to 1480 feet. This dust was deposited in water and assorted in layers. The surface of the lake was about 1480 ft. above tide, and had an expanse several miles wide in the trough and still wider in the Smoky Hill valley toward the north. These deposits are "a remnant of the latest general deposits of the plains" in that region. These beds are supposed by Udden to be the probable equivalent of some part of the "Equus beds" of Cope. According to J. E. Welin the volcanic dust is 5 feet thick at the N. E. corner, Sec. 14, T. 18 S., R. 3 W., McPherson Co. Cragin has called this dust "pearlette beds".

river. Mr. Wilson stated that below the "wash," which fills the trough already mentioned to the depth of 100 feet, is "soapstone," and that this soapstone rises in the hills to near the tops, where it is covered by a thin loam. These "hills" are the Cretaceous buttes referred to. The city water of Lindsborg which comes from the sand of this "wash," is very hard, and can hardly be derived from the Cretaceous. It may be shed into the trough by the lower-lying Carboniferous so as to gather in considerable quantities in favorable situations.

According to the account of Mr. Wilson, confirmed by others, the water of the flood of 1903 extended much more over the flood-plain between Lindsborg and Salina. From this it appears that the volume of the river in flood time diminishes on going upstream in comparison with the capacity of its banks,—in other words, the actual volume of the water, in comparison with the valley, diminishes upstream, indicating that the valley was not excavated by the present stream.

McPherson. At about six miles south from Lindsborg the Union Pacific railroad grade makes a slight cut in the Carboniferous (?) shale and shaly limestone, covered by a loam of about 4 ft. The country changes, getting away from the river, and becomes first slightly undulating as we get out of the valley toward the southeast. The Smoky Hills are in the southern part of Saline county, west from Bridgeport, and are composed of sandstone. At the limestone cut there appears toward the east a higher terrace, apparently 75 feet above the lower, or flood-plain, which

may be due to rock strata. The train soon gets onto this upper flat, which is undulating with some dissection, and as a "flat" it is soon lost. Without any observable ascent the road reaches its "summit" at Hilton, where there is a fine flat country with a heavy surface loam, the summit itself being a flat plain which extends to McPherson, but with a slight descent toward the south. There is no sign of any valley, either recent or old. The divide at Hilton is 160 feet above Lindsborg and McPherson city is 130 feet.

The valley described by Udden is said by Mr. Jeff Tourney, of McPherson, who as an alderman became familiar with the city's explorations for water supply, to be about seven miles wide and 175 feet deep.

East and west from the old valley, of which there is no sign on the surface, the underlying rock rises to within ten or twenty feet of the surface, as determined by drilling for wells. The same flat extends to Galva, eastward, from McPherson, and to Canton.

Without much attempt to correlate or discuss the foregoing observations the writer puts them on record for future use by others who may study the terraces of the Kansas valley. It would need more time than was available in gathering more facts, to warrant an attempt to treat this subject with such thoroughness as the geological questions involved seem to require.

Lake Udden. Probably the most important conclusion that can be drawn, at least tentatively, from the facts noted, as viewed from an archeological standpoint, concerns the origin and date of the great upper terrace which accompanies the Kansas valley. The

level of this upper terrace apparently blends into the level of a lake bottom whose waters covered the valley of the Kansas (or Smoky Hill) above Abilene. Whether this lake, which may appropriately be called Lake Udden, from the geologist who first noted it, was of late Tertiary date, or pre-Glacial Pleistocene, is not proven by the facts that are known; but it appears evident that it was older than the Kansan Glacial epoch. The writer is of the opinion that it may be found to date from late Tertiary time, and that probably the stream that then occupied the valley between the high rock bluffs, as at Manhattan, was the discharge from a large Tertiary lake lying over western Kansas and extending northward into Nebraska.

It would be well to study the Kansas valley at points eastward from the Kansas moraine, with special reference to the continuance or absence of this terrace. If it antedates the Kansan moraine it would be likely to be destroyed where the ice of that epoch buried the valley. The writer did not observe any terrace at Topeka, but at Lawrence there is at the depot a massive terrace which is excavated for brick, and which by reason of its color and location is more likely to be a dependency of the Kansas epoch.

Kaw Lake. This name has been given (by Smyth) to a Glacial lake formed in the Kansas valley by the damming of the Kansas river by the Kansas ice-sheet.* The necessary production of such a lake by the obstruction of the river by the ice and its moraine has already been referred to (p. 38). Ac-

*Kansas Academy of Science, "The buried moraine of the Shunganunga". Vol. XVI, 1896-97.

cording to Smyth this lake began at the "ice-dam" about two miles above Wamego station and extended above Manhattan, "westward on the Smoky Hill to Salina and northward on the Blue nearly to Blue Rapids." * * * "The depth of this lake at Manhattan was a little over 150 feet." Mr. Smyth has given the depth of this lake and of several other nearly cotemporary Glacial lakes formed in some tributaries of the Kansas from the south, at different places, viz., Mission creek, Mill creek and the Wakarusa river, which must have been nearly on the same level, though connected by broad streams. In only one place has he mentioned any shore line, or bench-marks proving the existence and the levels of any of these lakes, viz., on the sides of Burnett's mound, southwest from Topeka, in the Shunganunga valley. Mr. Smyth guided the writer to this place, where by some aneroid measurements some data were obtained from which some calculation can be made as to the extent of Kaw lake. The result of this calculation can be considered only approximately correct, but so far as it goes it throws light on the possible cause of the persistent terrace which accompanies the Kansas river. Bearing upon this are the following levels, partly derived from Gannett's Dictionary of altitudes (U. S. Geol. Survey), partly from statements of Mr. Smyth, and partly from aneroid readings by the writer.

Topeka	880 ft.
Ice-dam, 2 miles southwest of Wamego	980
Wamego	989
Terrace, south side of the river at Wamego	1010
Lower shore line on Burnett's mound	1035

Upper shore line on Burnett's mound	1065
Top of Burnett's mound	1115
Manhattan	1012
Abilene	1154
Salina	1226
Lindsborg	1241

Assuming the upper shore line on Burnett's mound (1,065 ft.) as correctly ascertained, and also that it expresses approximately the level of Kaw lake (though that lake may have been sometimes a few feet higher than this shore line) the depth of the Kaw lake at Manhattan, above the present railroad station, was 53 feet, and the lake could not have reached Salina (1,226 ft.) nor Abilene (1,154), nor Enterprise (1,137), nor Junction City (1,078), but it must have come very nearly to the junction of the Republican and Smoky Hill rivers. The terrace seen at the south side of the Kansas river opposite Wamego (1,010) appears to be, therefore, 55 feet lower than this assumed level of Kaw lake, and it may have been nearly cotemporary with the lower shore line seen on Burnett's mound, or it may express only the level of the bottom of Kaw lake. It is hardly worth while to consider the extent of Kaw lake on the supposition that the lower shore line on Burnett's mound indicates its surface level. It is 30 feet lower than the upper.

While it is probable, therefore, that the action of Kaw lake in the Kansas valley could not have produced the terraces seen above Junction City, yet it may be responsible for some terraces seen below that point. Artificial stone implements found on a terrace formed by the Kaw lake would be post-Kansan, and.

according to the foregoing classification, might be Early Neolithic or even Neolithic, and those found on the terraces above Junction City, on the assumption that they are due to an older Tertiary stream, might be Paleolithic, Early Neolithic and Neolithic, in the same manner as those that occur on the uplands outside of the valley.

It will be noticed that the hight of Kaw lake above Manhattan, as determined above, differs by 100 feet from that given by Mr. Smyth. As already stated, Mr. Smyth does not indicate what evidence in the form of shore lines or beaches, or other water marks, he depended on to reach this result, and only in one instance mentions the existence of any shore lines, in all his discussion, viz.: in Shunganunga river on Burnett's mound. It is from this datum that it appears that the level given by him (150 ft.) is much too high. If, however, it shall appear by later examination, that the shore-line on Burnett's mound is not at the (near) level of Kaw lake, and that other data will require that Kaw lake stood at 150 feet above Manhattan, it would be sufficient to carry the lake up the valley a little beyond Abilene at an elevation of 1,162 feet above tide. It would require a still further elevation of 32 feet at Abilene to bring Kaw lake up to the level of the extensive plain that extends northward from that city.

It is a desideratum that the Kansas terraces be carefully examined both in the interest of Glacial geology and from an archeological point of view.

IN OTHER WESTERN MUSEUMS AND PRIVATE COLLECTIONS.

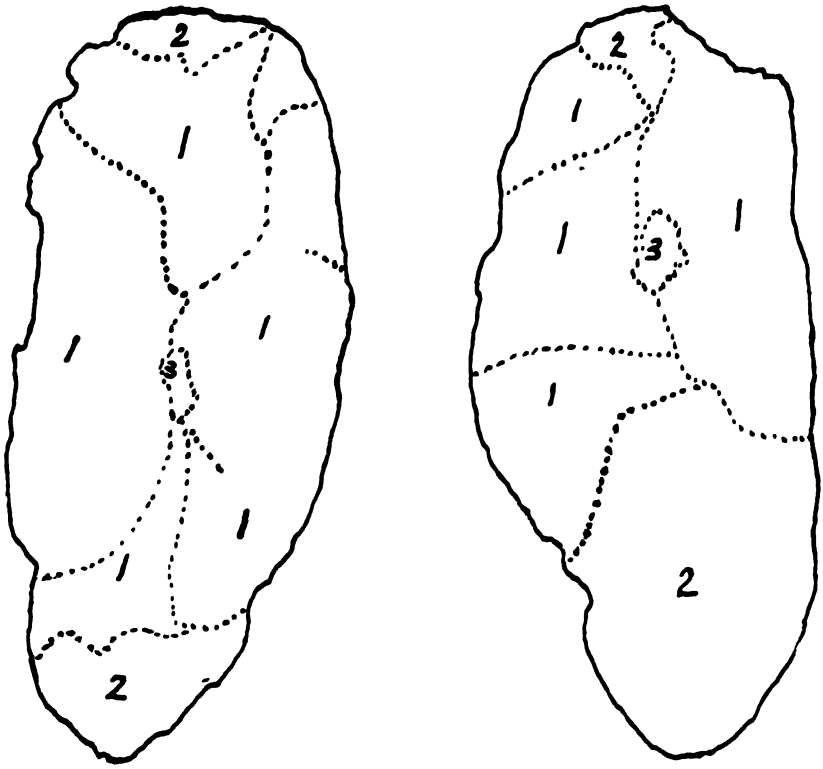
Lincoln, Nebraska. In the museum of the Nebraska Historical Society is a collection of aboriginal stone artifacts and a much larger one of textile and other articles. Among the former are specimens that fall into the Early Neolithic stage, both as to time and as to culture, some of which are of blue-gray chert and were obtained by Mr. Blackman in southern Nebraska.

Southward from Lincoln red quartzyte boulders were observed in a loamy drift about the head of Salt creek, perhaps ten mlies south of Hanlon, the contours of the surface being gentle but probably morainic. The drift is loess-like. An extensive flat then supervenes and extends to and beyond Princeton. This plain apparently was caused by having been the bottom of an extensive lake, perhaps of Tertiary date. It continues to Cortland, and in the drainage cuts reveals lacustrine clay, which clay, however, may be of later date than Tertiary. At Cortland this plain shows some dissection by local drainage. The general level then begins to descend toward the south, the dissection increasing, and a small creek forms, running south, no "drift" appearing either at Pickerell or at Beatrice. At Holmesville a chert-bearing limestone appears in the banks. It was near this place that Mr. Blackman found some rude artifacts which he assigned to the same class as those at Quivira, described by Mr. Brower.

Blue Springs. James Crawford's Collection. At Blue Springs and Wymore this chert is quarried extensive-

ly for road-metal. Its outcrops along the valley of the Big Blue river in this vicinity afforded material for the rude implements made by the aborigines, not alone for the late (Indian) aborigine but for his predecessors for many generations, and probably for many thousands of years earlier. Indeed, judging from the few specimens remaining of the collection of Mr. James Crawford, near Wymore, (Sec. 22, T. 2 N., R. 7 W.) who gave the bulk of his collection, through Mr. Blackman, to the Nebraska Historical Society, already noted above, this locality has been a resort for chert knappers since Paleolithic times. Mr. Crawford, an old settler since 1871, occupies a farm which is on the edge of the Kansas moraine, yet intersected by the erosion of the upper Carboniferous limestone by the river, forming rock bluffs on the crests of which the usual boulders of red quartzyte are common, along with some that are of granite, trap and red felsyte. These are brought to light by the rapid washing away of the thick surface loam under which the country is buried. There are no boulders visible in general in the upland fields. This loess lies directly on the Kansas drift, and it seems to be Iowan. These artifacts, therefore, so far as they are Early Neolithic and embrace the tomahawk, are probably post-Iowan, and apparently of the age of the tomahawks that lie on the great terrace of the Kansas valley. Still it is not certain yet, so far as present observation extends, that these artifacts were not buried beneath this loam, and have become superficial by washing away of the loam, in the same manner as the quartzyte boulders.

Mr. Crawford's collection, as presented to the Nebraska Historical Society, embraced tomahawks of the "tomahawk people" of Mr. Brower, and some large spatulate pieces. At his house was seen an old specimen outlined by the figures below, actual size, show-



Paleolithic Implement Re-chipped in Early Neolithic Time.

ing unmistakable Early Neolithic chipping. It was a rude knife or blade, and its latest chip-surfaces are so weathered as to show that they far antedated the Neolithic. The specimen is convex on both surfaces, and was given its form by chipping, which entirely covered it, the latest at the ends, apparently to give it fresh edges in Early Neolithic time. The figures show opposite sides of the specimen.

1. Patinated Paleolithic surfaces.
2. Early Neolithic chip-surfaces.
3. A bruise, or break, which appears on both sides.

Mr. Blackman's reports are published in the State Agricultural Society's reports, especially that dated 1902 where he presents several plates of "Harahey" and "Quivira" types, as defined by Mr. Brower, including a tomahawk of the typical form, which was found by Mr. F. E. Crawford on his father's farm. Most of Mr. Blackman's illustrations were taken, however, from the large collection of Mr. Walter Rice (Sec. 16, T. 2-7), which shows chip-surfaces that are Early Paleolithic (or pre-Paleolithic) and Early Neolithic. The pottery and polished stone axes in Mr. Rice's collection are, of course, of Neolithic date. These articles sufficiently show that the "Quivira" culture was not restricted to the typical locality in Kansas, but extended at least as far north as Blue Springs in Nebraska.

The Rotting of Chert.

Some important observations as to the weathering of stone artifacts were made at Wymore, viz.: some chert artifacts are so old that they are rotted nearly all through. That seen at Mr. Crawford's (above described) was rotted deeply, and this could be seen on the Early Neolithic surfaces, which were finely roughened from decay, while the Early Paleolithic surfaces still retained the brown patina scale, though broken by some hard blows at the places indicated (3). In Mr. Rice's collection are two small, Early Neolithic, buff-yellow artifacts whose surfaces are so

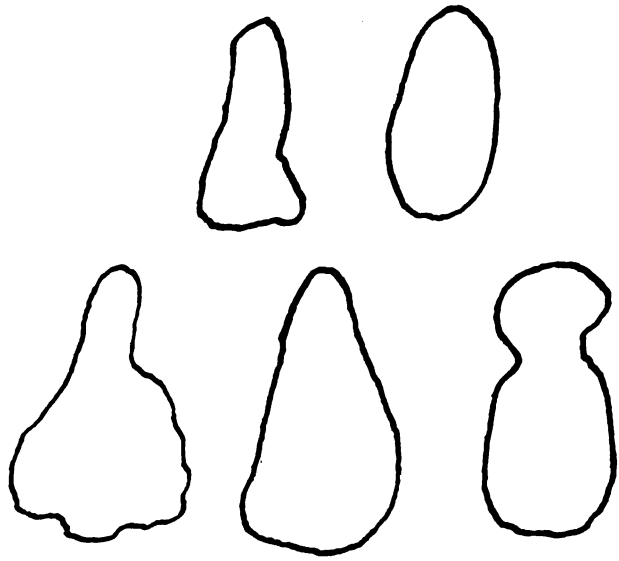
disintegrated in places that they give a loose fine powder when rubbed. They are thin, ovate, or ovate-oval, blades, and the chipping round the edge is also disintegrated. It appears, therefore, that since the Early Neolithic chipping these specimens have suffered such atmospheric attacks that the integrity of the chert has been superficially destroyed. It appears also that the patina scale formed in Paleolithic time served as a protection to the chert, excluding the destructive agents, whether gaseous or liquid, which might act on the granular texture of the chert wherever freshly broken. The Paleolithic patina, especially a gloss, smooths the surfaces so as to make them impervious, resembling glass. A fresh chert-fracture exposes the texture of the interior, and opens the fine porosity to the entrance of moisture and hence subjects the surface to freezing and thawing. It may be, also, that these rotted specimens, found at the margin of the Kansas moraine, have been liable to exceptional disintegrating conditions.

McPherson. Dr. Vance N. Robb has an interesting collection consisting mainly of Early Neolithic and Neolithic specimens and three Paleoliths from Indiana. He has also found Paleoliths at McPherson of which he exhibited several specimens. One is of white chert, one of siderite, now stained dark brown by oxidation, and one of yellowish quartzyte, also two double tomahawks of Early Neolithic date, one of which is of blue-gray chert.

Topeka. In the collection of W. E. Richey, now in the keeping of the Kansas Historical Society, are a few that are Paleoliths, some tomahawks of the "tom-

ahawk people," and flakes and rude knives of the same age, and numerous other Early Neolithic implements. He has two identical specimens, of twenty or more kinds, from two different localities (in sets), one from the Cottonwood basin and the other from the Smoky Hill basin, intending to show that the culture of the Indians had no bearing on the location of Quivira, seen by Coronado.

Kansas City, Mo. Mr. M. C. Long has a large and valuable collection, which, being boxed, could not be seen, but he showed me some samples made from a wholly rotted (or altered) chert. They are of a light



Outlines of specimens seen in the Pub lic Library.

buff color, finely versicular, and of low specific gravity, with an exterior more or less darkened by iron oxide. This chert has not rotted since the implements were made, but before it was taken from the

native formation. It is known as "cotton rock." They show Neolithic and perhaps Early Neolithic culture. They consist of a celt-like hoe, a hammer and two axes. The cotton rock is found in southern Missouri and southern Illinois.

A visit was made with Mr. Long to the Public Library, where can be seen, under bad illumination, a fine display of aboriginal material, but not much that can be considered Paleolithic. The outlines above show forms seen here which are possibly pre-Kansan. They are made of a light-colored chert which is common in Missouri artifacts.

The collection also embraces some English and French Paleoliths.

St. Louis. Dr. H. M. Whelpley has a remarkable private collection, to which I was conducted through the courteous introduction of Dr. W. F. Parks. Dr. Whelpley has more than 500 hematite axes, and also several of kidney iron ore. The latter are coated with a scale closely resembling hematite, and when the scale is unbroken can hardly be distinguished from genuine hematites. In Dr. Whelpley's collection can be seen evidence of the great length of the "Neolithic" period of aboriginal culture, inasmuch as he has a lot of chert chips and Neolithic long knives, well trimmed and handsome, of a light-colored, dense chert, from Union county, Ill., which are covered with a thin scale, or at least with a staining of a reddish-brown color, quite similar to the color patination of Kansas specimens. The length of time necessary for such alteration, in the case of this dense chert, in the opinion of the writer, would carry their fabrication into pre-Wis-

consin time, and hence into what is distinguished, in this article, as Early Neolithic.

It is a remarkable fact that implements of kidney iron ore, of Neolithic culture, have been so long made that they have acquired a thick scale, even a double scale, of iron oxide. Along with some problematic pieces of elongate but rectangular shape, were seen some celts, some semi-globular discoids and several axes, made of this ore. He also has some siderite implements that were at first naturally shaped by the partings of the rock and had acquired in situ an original scale of oxide, after which they were worked to an ax or chisel form, especially by the grinding at one end to an edge. After this working the ground surfaces have also oxidized so that the whole implement is covered with an iron scale. But I think there may be a perceptible difference between the old iron scale and the more recent. Prof. George H. Perkins has illustrated an ax of clay iron stone from Vermont, also much altered superficially, in Am. Nat. Dec. 1885.

Dr. Whelpley also exhibited a series of rude, large, elongate-ovate or wedge-shaped celts (or axes or what?) of Paleolithic making and style of chipping, which seem to be as late as Neolithic in weathering. They grade from a length of 20 inches to 2½ inches or less. They seem to belong, as a class, with the rude Neolithic intrusive culture of which evidence in Kansas has already been mentioned (pp. 128-130).

The large Neolithic chert "spades," so-called, which are common in southern Illinois, are made, according to Dr. Whelpley, from a dense chert which occurs in thin layers in a sort of clay, and that hence the na-

tives easily procured it by digging in the clay. There are extensive chert workings in Union county, Ill. Many (or most) of the implements made from this chert, so far as seen, are fresh and quite light-colored.

The museum of the Academy of Science, St. Louis, contains nothing in stone work that is Paleolithic, and but little that is aboriginal. But it has a large collection of pots of earthen ware, unlabeled.

The archeological collection of the Missouri Historical Society (St. Louis) was boxed and has been since the Louisiana Purchase Exposition.

Cincinnati. The Museum of the Cincinnati Society of Natural History has a large collection of human skulls, aboriginal and probably largely from mounds, many celts, axes and hammers, also rolling stones (or "pins") pestles, discoids, globular stones, gorgets of bone and of stone, many animal bones, earthen pots, arrow points, leaves and drills, but nothing that is actually Paleolithic. Although some leaves and celts are coarsely chipped, they show by the polish at the end that they were at least used by the latest stone-chipping people, and may have been made by them. Most of the stone celts are wholly ground.

At the Art Museum, Cincinnati, is a very large and well-displayed collection of aboriginal material of which the stone artifacts arranged geographically are an important portion, included in the "Cleneay collection." They are mainly from the Ohio valley, and extend from Pennsylvania to the mouth of the Ohio, and further, on both sides of the river. Many others were presented by Gen. M. F. Force. There are but few of Paleolithic or Early Neolithic significance, viz.:

1. There are a few coarse-chipped leaves, but nothing to show that they are pre-Glacial.

2. There are several old axes of syenyte, or gabbro (or dioryte) which are deeply decayed, like one in the Brower collection which is said to have been taken from the bottom of the Ohio river. These are grooved, but there are many that are not decayed.

3. Two glossed, ovate or ovate-oblong leaves or knives, from Belmont, Campbell Co., Ky., of dense pink-gray chert. (It is noticeable here, as elsewhere, that the implements of large size (axes, pestles, hammers) when not made of native material, which is rare, are of some variety of greenstone. This is due probably to the fact that such stones endured after the Kansas epoch better than the granite rocks, which crumbled by decay). Hematite specimens are distributed through the collection.

4. Two other similar pieces, one of light chert and the other of gray chert. They do not show distinct gloss, and their only apparent Paleolithic character is their coarse chipping, locality not stated.

5. Two others of "flint," i. e., gray chert of similar appearance.

6. Part of a deposit of 1500 found in 1872 at Beardstown, Cass county, Ill. These number 14. Two or three of these show the supposed Glacial calcareous patina (f) described on page 10. Their thickness is from ½ inch to 1 inch. The age of these caches is problematical. It is not presumed by the writer that they are Paleolithic, as to date, though they show a rough chipping resembling the work of the Paleolithic people.

The main part of the entire collection is Neolithic, and of the stone artifacts but a portion are Early Neolithic. This is indicated by the nature of the implements, their finish and the comparative freshness of the surfaces.

Columbus. In the museum of the Ohio Archeological and Historical Society are archeological materials as follows, which indicate great age, probably Early Neolithic.

1. Semi-rotted hammers of granitic rock.

2. A lot of unfinished specimens of quartzyte from the District of Columbia.

3. Siderite celt and siderite long celt covered with oxide scale (in the Moorhead collection).

4. Part of a large collection found by Moorhead, consisting of oval or ovate-oval chert blades or "blanks" of gray chert (four pieces). These are distinctly glossy, but less so than those seen at Cincinnati.

5. Paleoliths (two) from Dr. John Evans of England. These are of the same chert and appearance as those illustrated on plates I and II, Nos. 2228 and 2229.

The most interesting thing in this museum is the display of the findings in the Harness and other mounds, explored lately by Prof. Mills, in one case showing a succession of peoples or tribes which occurred during the mound builder dynasty.

Newark, O. On the "Flint" ridge, ten miles southeast of Newark, at a 4-corners, at Clark's blacksmith shop, is said to be one of the chief workshops of the aborigines. Here are many pits, and the ground is

covered with chips of all shapes, of which I collected enough to fill a small "telescope" when packed for shipment. This is near the center of Hopewell township. The pits and workshops cover about two acres, about the four corners, and extend further south. I cannot say that I found anything certainly Paleolithic, although there are some old, yellowish-brown surfaces, which, however, may have been caused by rusted, pre-existing jointage or cleavage planes, rather than by open atmospheric exposure. Mr. Clark said that he does not believe that the present Indians did the work. It is probable that in that he is right, as the work is rather attributable to the Ohio dynasty of the Moundbuilders, or to some of their predecessors.

It would require much time to determine whether Paleolithic man had any part in making these excavations. The location, as in Kansas, is not only favorably near a chert-bearing limestone ridge, but is quite near the southern limit of the greatest known continental ice-sheet. Only scattering pebbles of northerly drift are seen on the ridge at the western end. It is a promising location at which to look for Paleolithic artifacts. Large craggy masses of chert, more or less diversified by quartz and amethystine geodes, are a common feature on the slopes.

Cleveland. At the museum of the Western Reserve Historical Society the Newcomerstown "Paleolith" found by Prof. W. C. Mills in 1889 can be seen. It is of "black chert," but is variegated with fragments of fossils which are whitish on the surface, and with some porosity, as well as with some small remaining

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PALEOLITH. NEWCOMERSTOWN, O. PAGE 162.

part of the limestone with which the chert is associated, the last not being glossy. Otherwise the specimen is glossy. The longer edges were battered by use prior to its having been incorporated in the gravel, on one side more than on the other. The gloss and the generally unworn surface, and the sharpness of the outer angles, all indicate that as a constituent of the gravel terrace it had not much experience before coming to rest in the terrace, but that the most of its life history transpired prior to the gravel deposition. The sides are about equally glossy. If the gravel terrace be found to be a consequent of the Wisconsin ice-epoch, it appears therefore that this implement originated earlier, and falls into the culture as well as the date of what is herein called Early Neolithic. Its date is pre-Wisconsin, but not pre-Kansan. (Compare No. 5715 of plate XIII.) It is noteworthy that like numerous Early Neoliths and Paleoliths, it was most used along its lateral edges instead of on its ends. This specimen has been described by Dr. G. F. Wright in Tract 75 of the Western Reserve Historical Society, Vol. III, April 14, 1890, and in Popular Science Monthly, May, 1893. The form of this specimen is quite common among the Kansas artifacts, and had a wide range in aboriginal stone art. It is referred to on a former page under *Celts* (p. 123). V. plate XVI.

Chicago. In the Field museum (1) in the case showing the archeology of Alabama, Florida and Arkansas, are about 40, rudely chipped, celt-like and knife-like implements of chert from Decatur county, Tenn., the appearance of the culture of which seems to be Paleolithic. On the label they are called "Im-

plements and rejects." The material is not dense and siliceous, and they are not much glossy. They are from 4 to 8 inches in length.

2. In the same case are some "flint implements and rejects from the banks of the Kansas river, J. V. Brower." These are ten in number, two tomahawks, three rude tomahawks but not notched, three small knives or arrowpoints, and the others are nondescript or purposeless. They are of blue-gray chert, somewhat mottled, in color as well as in grain, all Early Neolithic No. 1 of this paper.

3. So-called "flint disk-like implement," Beardstown, Ill., evidently from the great cache found there. This is dark, almost black, glossy.

4. Leaf-shaped, brown, quartzyte implements from Illinois.

5. In the Clark and Hopewell mounds, Ross county, central Ohio, which are situated in the "second terrace" along with many remarkable other discoveries, Mr. Moorhead found a cache of flint disks numbering in all "over 7000." From this lot specimens have been distributed to various places, but an enormous conical stack of them occupies one of the glazed cases. They are oval and ovate. The total taken from the mound (No. 22) is 8,185, including those taken out prior to Moorhead's discoveries. They are of a "light blue-gray color," made from flint nodules found in Indiana and Tennessee, considered not finished implmeents but "roughed-out" raw material, to be elaborated as required. Some of the edges appear slightly battered, as if by use, but generally the finer chipping about the edges may be referred to the chip-

ping incident to their formation. Some of them appear to be sub-glossed, but perhaps owing to the dust which obscures them, I could not see that any marked glossiness exists on them. They have a general smoothness which in some cases appears to approach a gloss, which denotes considerable age but not characteristic of Early Neolithic time. They must be later than the terrace on which they were found, and hence probably are post-Wisconsin.

6. A stone celt, found with skeleton 262, mound 25, of the Hopewell group, is coated with an incrustation of light gray color, probably caused by the decay of the bodies or other organic matter, as it shows the maggot-like forms which I have before noted on mound articles. The celt is of chert, apparently, and about seven inches long, and was worn smooth by use at the broad end before it was buried. This celt and its culture indicate strongly the Neolithic age of the mounds, as do all the other important discoveries in the Hopewell group, with the bare possible exception of the cache of 8,185 oval cherts, and without further proof to the contrary the cache itself has to be assigned to the same date. Still, it is a remarkable fact, according to Moorhead (Stone Age in North America, I, 220), that the chert of these oval disks came from northwestern Tennessee while "most of the chipped objects on the village sites of the Hopewell group and in the mounds were made of Flint Ridge material." This difference of source of the chert may warrant the suggestion that the cache of disks may not be due to the same people as the other implements.

There were found also several other stone celts,

"one in an unfinished state," being of different rock and also containing what appears to be a "glacial patina," about the broader edge. On one of the others is an incrustation (slight) which may be due to organic decay, or to glacial patina. A similar white incrustation is found on some of the chert arrowpoints "found with skeleton No. 186, mound 23."

7. In a case near the north entrance are European artifacts, Paleolithic and Neolithic. some of the former called "flint rejects," chiefly from county Down, Ireland.

8. In the same case a "series representing the process of manufacturing flint implements," embraces mainly Paleolithic artifacts from ancient Egypt.

9. Paleoliths are here also from Egypt, Somaliland ("rejects"), and from Poondi, near Madras, India, the last being labeled "Paleolithic implements," also from England, from the British Museum.

10. The Martin A. Ryerson Swiss Lakes collection contains only Neolithic stone artifacts.

Milwaukee. In the Public Museum, after a fruitless search through the cases and the most of the drawers containing "refuse stuff" and duplicates, a single oval Paleolithic "blade" was found in the last drawer opened, not of European origin. The chert is gray and apparently made up largely of sub-rounded small grains of chert in a matrix of chert. It is patinated with yellowish, or ochre color, and has a gloss that is distinct all over. Its longer diameter is 6¼ inches, its shorter about 4¼ inches. It was through the courteous aid of Curator S. A. Barrett that this implement was found, and by the kindness of Direc-

WISCONSIN PALEOLITH IN THE PUBLIC MUSEUM.

MILWAUKEE. WIS. TWO-THIRDS ACTUAL SIZE. PAGE 166.

tor H. L. Ward that the accompanying illustration (three-fourths actual size) is presented (plate XV). Its number is $\frac{13333}{2677}$ and on searching the records it was found to have been derived from Adams county, Wisconsin, which is outside the line of the Wisconsin moraine, but quite near it. This specimen has the form of a true Paleolith, as the term is used in this discussion, but its age is likely to be post-Kanson, i. e., Early Neolithic.

Madison. (1) The museum of the Wisconsin Historical Society contains a collection of rude artifacts from Seneca, Mo. They are made of a light-colored chert, similar to that of some large spears and knives ("points") in the Brower collections, derived from Missouri. On breaking one of the triangular flakes, Curator Brown found the light color is not due to a patina, but that the material is white within; but on close inspection it is to be noted that the interior whiteness has a whiter scale, evidently due to weathering. This locality has been described by Dr. W. C. Barnard in "Records of the Past," October, 1905. To the writer it seems quite probable that the Newton county (Okla.) working is as old as any in Kansas, although no certainly Paleolithic artifacts from there have been seen as yet by the writer.*

(2) At Crescent, Mo., is another similar old working of which some chips and implements are in the same case, given by Dr. H. M. Whelpley, of St. Louis. These, and the above, are labeled "rejects and rough-

*Dr. Bernard sent subsequently, in exchange, some white quarry pieces and a collection of turtles and points from Newton county, Mo., the latter of Early Neolithic age.

ing-out material." They may be, however, Early Neolithic, or even Paleolithic in part.

(3) In the same museum are a lot of glossed chips, etc., from the so-called Spanish diggings and Indian quarries in Converse and Laramie counties, in Wyoming, presented by Robt. F. Gilder, embracing quartzyte and chert of various colors, some of them of flint, proper, i. e., apparently of fossil wood.

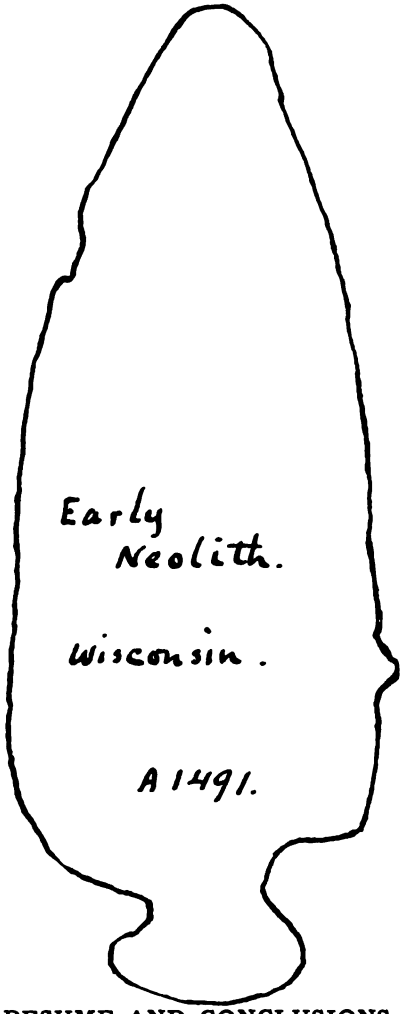
A collection of these from Mr. Gilder, from near Fairbanks, Wyoming, are certainly of Early Neolithic date, and possibly earlier. Mostly of quartzyte, like the Potsdam of Minnesota, they are also of chert of different colors, and one (of flint) is flecked as if fossilliferous with fine angular fragments.

(4) Contents of two caches at Richland City, Wis., gray chert, roughly chipped "blanks", deposited by Charles E. Brown. These pieces are smaller than those of the cache in the Hopewell mound, found in Ohio by Moorehead.

(5) Rhyolyte material, Blue Bell bay, Puckaway lake, Green Lake Co., Wis. Some of this is very old, as shown by the change of surface color and by the culture, dating probably from pre-Wisconsin time.

(6) Specimen numbered "A1491", in another case, is outlined by the figure below. It is notched at the broad end as if to be applied to a handle. It differs from all others in the cases, as far as seen, in having a yellowish patina and gloss, similar to that seen at Milwaukee. It is of light gray chert. I could not learn the source of the specimen. It falls into Early Neolithic time both by its weathered condition and by its culture. Plate XVII.

WISCONSIN EARLY NEOLITH IN THE MUSEUM OF THE



RESUME AND CONCLUSIONS.

Resume. The reader who has perused the foregoing pages devoted to "a consideration of the Paleoliths of Kansas" will be glad to have the main results brought into a smaller compass. For this purpose a resume of the steps along which the investigation has been prosecuted will be a suitable introduction.

1. The Kansas artifacts are of at least three different and successive dates. This is shown by a comparison of the oldest with European Paleoliths which they resemble in patination and in culture, and by the fact that the rudest implements have been taken as basis for the making of nicer implements by later working. Therefore the Indians found in the Kansas valley (Wichita) who were supposed by Mr. Brower to have been the fabricators of the oldest implements, were in no way connected with their manufacture.

2. The blue-gray chert of the Upper Carboniferous in Kansas is abundantly exposed in the region. The specimens made from it, when old, are covered with a patina which varies in color and kind according to the length of time exposed and the nature of the exposure, six of these kinds of patination being noted and described.

3. The characters of the oldest implements indicate that the Paleolithic artizan was satisfied, in the main, with the acquirement of an edge, but he also brought his implements into an ovate, or oval, or squarish shape, and, as found later, he occasionally drew them out into the form of parallel-edged knives about eight or ten inches in length.There are no Paleolithic scrapers, nor points, nor drills, and knives only that occasionally are elongated with two nearly parallel edges.

4. There was found to be a stage of culture, as well as of patination, intermediate between the foregoing and the Neolithic, in which are found finished knives (the "Harahey knife" for example), points which were used as knives, as well as knives of delicate elongate form and fine chipping; also scrapers,

blades, spears and arrow points. It was found that a large majority of Kansas artifacts fall into this group.

5. In order to form a preliminary classification four time-classes were designated, viz: Early Paleolithic, Paleolithic, Early Neolithic and Neolithic.*

6. These specimens are found further south than the Kansas moraine, but not far from it, and closely adjacent to the outcropping chert of the Upper Carboniferous. The Paleolithic, Early Neolithic, and the Neolithic are found sometimes mingled at the same sites, indicating a succession of people who chose for habitation the same situations, resorting to the same chert beds for material, and probably resembling each other in many ways.

7. The Indians met by Coronado in Kansas were the Wichita and the Pawnee, both of Caddo stock, the former the Quivira, of Brower, and the latter the Harahey.

8. In this paper the term Paleolithic is applied to any people, and their artifacts, which antedated the Kansan Glacial epoch. Early Neolithic includes the time elapsed between the Kansan and the Wisconsin Glacial epochs, and Neolithic applies to people who have existed in Kansas since the Wisconsin.

9. It was found that only at one point in the scale of culture is there a marked transition to a higher type. That occurs at the passage from Paleolithic to Early Neolithic. Early Neolithic culture is found to continue to, and into, Neolithic, and can be separated from Neolithic, so far as expressed by the Kansas

*Later it has been found convenient to subdivide again, viz: Early Neolithic No. 1, and Early Neolithic No. 2; also Neolithic No. 1 and Neolithic No. 2.

specimens, only by the marked glossiness which denotes greater age for the former.

10. It was also found that Paleolithic types did not cease with the close of the Kansas Glacial epoch, but continued into, and through, Early Neolithic, and even into Neolithic time.

11. In weathering the first effect produced on a piece of chert is the formation of a gloss. This gloss may be lost by decay, or it may be replaced by a colored (or white) weather-scale which is not glossy but yet smooth, and still later the brown weather-scale may be covered by a white scale. The color of the scale depends on the presence or absence of iron dissolved in water having access to the specimen.

12. As a general principle: all Paleolithic art was perpetuated, or may have been perpetuated, into Early Neolithic and Neolithic time, and all Early Neolithic into Neolithic; and hence the progress of stone chipping was essentially a continual introduction of new forms and higher skill without the necesasry loss of any of the older forms.

13. Early Neolithic man seems not to have been entirely ambidextral, but used his tools most with his right hand.

14. Near the close of Early Neolithic time a new and coarse type of stone chipping was introduced into Northeastern Kansas, so coarse that though the implements made were about the same in kind as those of the Early Neoliths, yet the skill displayed in the making of them was not much in advance of the Paleoliths. Page 130 and Plate XIX.

15. This new culture may have been introduced as a consequence of climatic change that inaugurated the Wisconsin Glacial epoch, and in the terms of this paper, is actually Neolithic. (Neolithic No. 1).

Conclusions. The people of the Iowan Glacial epoch, represented by the skull and skeleton found in the loess at Lansing, Kansas, probably took part in the making of some of the Early Neolithic implements found on the Kansas upland interior, and were a part only of a wide-spread race which, we may assume, occupied much of the interior of North America. Their bony skeleton and their skull, as well as their culture, did not differ noticeably from those of the modern Neolithic man as represented by the historic Indian. This statement is based not only on the foregoing researches but also on the opinion of Dr. Ales Hrdlicka* who stated:

"Considered anthropologically, all the parts of the skeleton, and the skull in particular, approach closely, in every character of importance, the average skeleton of the present-day Indian of the central states. Zoologically, as well as in growth, the Lansing skeleton and the skeleton of the typical present-day Indian of the upper Mississippi region are of the same degree and quality."

This coincidence of archeological results with those which are more strictly anthropological is interesting and suggestive. At the time of the discovery of the Lansing skull and skeleton there was considerable discussion as to their age, and owing to the affinity which was apparent between the Lansing man and the his-

*American Anthropologist, V. 323, 1903.

toric Indian, and especially because some leading authorities in America discredited the existence of man in America earlier than the Wisconsin ice age, there was a tendency also to discredit this discovery, and to show that the loess in which they were found was not true loess of the Iowan epoch, but was formed by a "slide" of late date, or belonged to the alluvial deposits of a small stream which there joins the Missouri river. But by the light thrown on the subject by these artifacts, dating from between the Kansan and the Wisconsin epochs, it is clear that the culture and therefore the ancestry, of the historic Indian extend backward far beyond the Wisconsin Glacial epoch, and it is not at all unreasonable to expect to find the skeleton and skull of the Indian, in all important respects, not dissimilar to those of his ancestors.

In Europe, in Asia and in Africa, and even in South America, as well as in Australia, remains of men have been found which archeologists and geologists have accepted not only as pre-Glacial but sometimes Early Pleistocene and even Tertiary. Those found in Argentina, South America, are questioned by some, it is true,* but with that exception the rest of the entire globe, with its principal geographic divisions, has afforded evidence of the great antiquity of the human race. To exempt North America seems not only anomalous but more unreasonable than to welcome all the evidence which has accumulated going to show

*The South American evidence has recently been reviewed by Hrdlicka, and, as in North America, has been questioned and discredited. Bulletin 52, Bureau of American Ethnology, 1912.

such antiquity here also. On such a question it is safe to be very cautious and conservative, but it behooves men of science, on the other hand, not to carry their conservatism so far that it passes into unreason. It appears now that the existence of Paleolithic man in America has been supported by so many witnesses that it is beyond "reasonable doubt."

If man has existed in America since pre-Glacial time archeologists will naturally look for some trace of his industry and art. Not to mention the ancient ruins in Central and South America, the dates of which are not yet determined but which may be older than the Wisconsin Glacial epoch, it appears to the writer altogether possible, and even probable, that many of the stone implements which, in the museums of the United States have been classified as Neolithic, had their origin earlier than the Wisconsin epoch, and would fall into the class Early Neolithic, as here defined, and that hence a critical re-examination would lead to a general division of our American stone artifacts into Early Neolithic and Neolithic, based mainly on the degree of patination. That would bring perhaps a majority of the stone artifacts of America (here called Early Neolithic) into chronological equivalence with those which in Europe are considered of "Neolithic" date, and would also make the actual Neolithic (i. e., post-Wisconsin) implements of America substantially parallel with the bronze and iron ages of Europe. There is reason to believe that after the last Glacial epoch had subsided in Europe, extensive migrations from Asia introduced bronze and later iron, into the renovated

lands, and that these metals then first became common in the fabrication of such tools as had before been made of flint; but that the stone age was perpetuated in America until after the Columbian discovery, only because no such post-Wisconsin Asiatic migration flowed into America.

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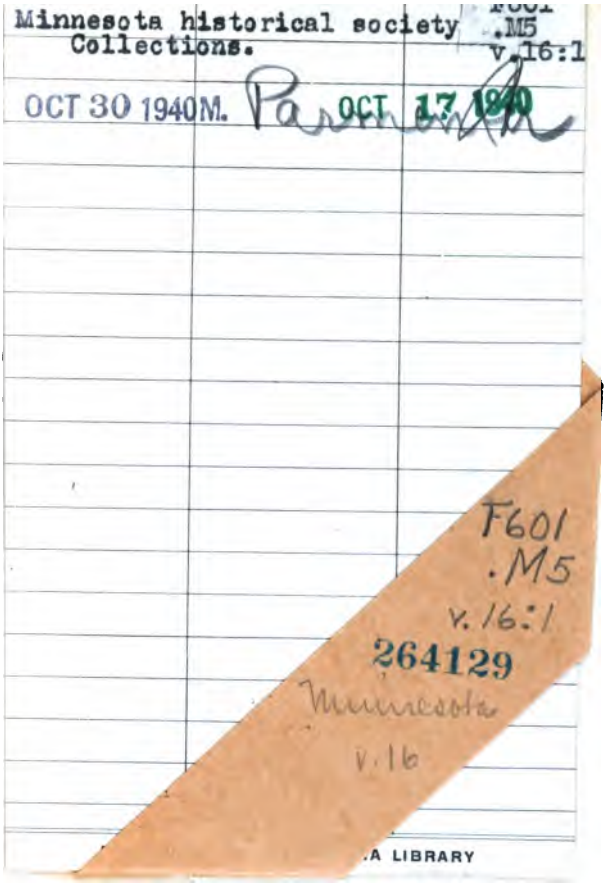
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